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## IOWA ELECTRICAL ASSOCIATION.

Elsewhere we print a full account of the very successful meeting last week of the Iowa Electrical Association, which report we commend to the attention of those interested in the live questions affecting particularly the smaller central stations. If the Iowa Association can keep up the pace set by this meeting, it will easily be the leader among the numerous electrical bodies of its class, for the meetings of none of the latter have in the past several years equalled that just held at Dubuque, whether judged by selection of topics or by the interest manifested in their discussion. As will be seen, the programme was a well-rounded one, and notable in dealing with the most recent methods of obtaining business and the latest developments in electric lighting, including consideration of the new tantalum lamp, the small carbon arc lamp and the Nernst lamp—which latter, by the way, received warm commendation based upon central station experience. The papers, moreover, were not of the perfunctory class which, while perhaps making a good showing on a programme, are so deadening in effect when inflicted on an audience.

The very excellence of the programme at Dubuque, however, suggests a word of caution, which will also apply to similar associations. With a membership necessarily limited, and conditions limiting also the opportunities of members to contribute year after year papers on the same central station topics without repetition of subject matter, the preparation of the programmes for such associations is much more difficult than in the case of the national electrical bodies, which are enabled to draw upon a larger membership with much more varied experience, and, on the average, with wider opportunities. It has been owing to lack of proper consideration of these circumstances that the course of many of the smaller associations has been so uneven—one year attracting wide attention through a meeting excellent in programme and discussion, and then dropping almost out of sight for a period, A remedy indicated is the appointment at each annual meeting of a programme committee, including the secretary of the association, which shall be required to commence work at once on the programme of the next meeting, and to report frequently—perhaps monthly—to the president of the association or to the executive committee on the progress of its work. If it is properly constituted and has an intelligent idea of its responsibilities, such a body should be able to arrange annually for an excellent programme of papers on live topics interesting particularly to the association membership, thus obviating the present practice of filling in the programme at the last moment by hurry calls and usually with little regard to topics or the competency of those appealed to for their treatment. Above all, this plan would afford opportunity for correspondence to enlist the interest of members particularly qualified to contribute to the discussion of the topics chosen, which part of the proceedings of associations is almost always of the livest interest and frequently of the greatest value.

## LINE EFFECTS DUE TO A MOVING LOAD.

The article by Mr. Carl P. Nachod on page 800 of this issue is of service in outlining an analytical study of the distribution of current, potential and energy lost in circuits supplying power from two points to a locomotive traversing the distance between them. The assumption is made that the electromotive forces impressed upon the circuits at the two points are equal in value, and that the impedance of the circuit from each point to the load varies directly with the change

in distance of the locomotive from that point. Since the power delivered to the circuits is considered as being constant, the problem resolves itself into one involving the determination of the distribution of a constant amount of current over two circuits in parallel, the impedance of each circuit being variable, but the total impedance of the two circuits being constant. Since, obviously, the division of the currents in the branch circuits varies inversely with the impedances, it follows that the amount of current supplied from each feeding point decreases uniformly from the full value when the locomotive is at that station, to zero when it is at the other end of the line.

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In the determination of the power lost in the circuits, the assumption is made that the impedance is composed exclusively of resistance, and, on the basis of constant terminal electromotive forces, the total power absorbed by the circuits is found to be represented by values which follow a parabolic law with reference to the distance of the locomotive from its central position. It is worthy of note that a similar relation would be found to exist if the reactive portion of the impedance were not neglected. It is well to observe, however, that a slight change from equality of the electromotive forces at the two feeding points, such as would be produced by the drop in the primary transmission line to the sub-station, would alter both the distribution and the resultant value of the power lost in the two component circuits, the value given in the article being the minimum, which can be obtained only under perfect operating conditions. The constants of the circuits, as assumed by the author, represent actual values existing in practice, the ratio of 1 to 1.83, between the resistance to direct current and the impedance to 25-cycle alternating current, being based upon test data. It is evident that in the iron portion of the circuit the crowding of the current to the outer edges of the rails does cause an appreciable increase in the power component of the impedance when alternating current is used, and that a considerable portion of the impedance is true resistance. In the copper part of the circuit, however, practically the whole of the increase in impedance may be attributed to the reactance, and it is apparent that the reactance of the total circuit is not negligible. It would be interesting to ascertain to what extent the change in impedance of the rail is due to the reactance, how much is attributable to the crowding of the current, and what effect the shape of the rail and its tempering have upon the distribution of the current.

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## THE NATIONAL ELECTRICAL CODE.

A meeting of the National Conference on Standard Electrical Rules was held in Boston last week, the proceedings and antecedent history of which have special interest for our readers. As soon as electric lighting came into recognized public use in this country, about the year 1880, it became evident that along with the great advantages and conveniences which attended the use of the arc lamp and of the incandescent lamp, there were accompanying risks and dangers. For example, an arc lamp gave a magnificent light easily controlled. If, however, a naked and unprotected arc lamp were suspended in a store window surrounded, say, by highly inflammable material, small cinders and particles of glowing carbon might readily fall from the arc and start a fire. Again, it was recognized that in a series arc circuit the voltage attained might, under certain conditions, be sufficient to give a dangerous shock to a person coming into contact with the bare conductor. Consequently, electric lighting soon became the subject of special consideration and restriction at the hands of fire insurance underwriters and of municipal authorities. In Europe, the municipal restrictions that were thrown about the new industry were often sufficient either to strangle or to hamper its growth. In the United States, the greater freedom of action pertaining to a democratic country permitted the growth of electric industries at a much more rapid rate. European city authorities, witnessing this growth and realizing that the dangers had been exaggerated in the first instance, ameliorated their stringent measures and gave more favorable consideration to the newer types of electric illumination. Even to this day, however, some European countries, notably France, have maintained regulations so rigid as greatly to hinder the development of electric applications to lighting and power distribution among urban communities.

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It is now generally admitted from experience that the fire hazard of electric lighting, installed with reasonable care, is less than that of gas, oil or any other illuminant in use, so that it cannot be maintained that electricity has become a menace to property or to insurance interests. On the other hand, it is also generally admitted that careless wiring, using defective materials, may readily create a materially greater fire hazard than that of oil or gas, by which on the average and in the aggregate a heavy additional fire loss would be encountered. It will not be questioned by the reasonable that, in order to prevent fire hazard from being unduly created by improper electric installation, rules governing installation are necessary. Such rules exist wherever property is insured, all over the civilized world. If the installation is made according to the particular set of rules in force, the fire hazard is accepted by the insurance company at its regular rates. If the installation is held to be inferior to the condition called for by the rules, the insurance company may decline to accept the hazard, or may charge a higher rate of insurance, unless the installation be amended in its defective particulars.

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The question as to insurance rules is not whether there shall be or shall not be rules. That question has been settled affirmatively for all time within prospect. The question is whether the rules shall be mild or severe, and also whether they shall be uniform or vary from city to city, or even from district to district in one and the same city. This is a question which vitally affects the electric industries. A good set of rules, which is not unreasonable or unduly stringent, is a benefit to electric industries because it prevents dangerous installations from being made, and tends to promote public confidence in electrical applications. If there were no check upon careless construction, the public might take alarm, and through municipal legislation arrest the growth of electric industries. On the other hand, an unreasonable or harsh code of rules is a serious and unnecessary hardship to those engaged in electric industries. Again, even though the rules are fair and reasonable, it is most undesirable that they should differ appreciably from place to place, since an article of manufacture for electric installation may have to be varied indefinitely to suit different local codes. In the year 1896 there were a number of codes of wiring and installation rules in force in different parts of the United States and a national conference was called to consider the possibility of their unification. A delegate was sent to the conference by each of the national societies representing insurance, electrical, architectural and allied interests. Electrical interests were represented by a delegate from the American Institute of Electrical Engineers and one from the National Electric Light Association. As the result of that conference a committee was formed to draft a code of rules for universal application if possible. This code was called the "National Electrical Code." This was completed after some months of committee work, and by 1897 the code was approved and adopted by all of the national bodies taking part in the conference. Since that date there has been practically no other code in force in the United States, and the various pre-existing codes have been placed on shelves, a great blessing for the electrical industries.

Since 1897, however, a number of changes have taken place. With the growth of electric applications new rules have been rendered desirable, while the amendment of some old rules has also become a recognized necessity. The latest edition of the "National Electrical Code" has about twice as many pages as the first edition. These amendments have been made by the committees of the National Board of Fire Underwriters at annual meetings in New York set for that purpose. Notices of these meetings and of the matters coming up for considered amendment have been issued to the national bodies in the conference, but the amendments have not been formally ratified by those bodies. Meanwhile the application of the rules has not been without friction between the insurance interests, represented by inspectors, and the electrical property owners and constructors, represented by central station managers and manufacturers. It is inevitable that there should be disputes and friction over questions as to whether installations or details thereof are, or are not, according to the specifications and rules of the code. Such disputes would be likely to arise between representatives of the insuring and constructing interests, even though endowed with great experience, diplomatic ability and discernment. These qualities are not to be everywhere expected on both sides of every debate all over the country. Nevertheless, such disputes may involve large sums of money. Again, the mandatory power that an insurance inspector may possess in condemning apparatus and equipment is becoming so large that the manufacturers complain of their liability to have whole lines of expensive machinery rendered unsalable for reasons that they consider inadequate. Finally, an aggravating feature has been that different interpretations have been given to rules in different insurance districts, thus frequently causing losses to contractors undertaking work outside of their usual territory. Such questions have recently been acquiring sufficient importance to call for general consideration, and the recent convocation of the National Conference was, therefore, lately asked for. The objections of the electrical interests are not against the National Code of Rules, but rather to the mode of its application. Certain plans of appeal from inspectors' rulings were outlined at the conference. It was also voted to convene the conference annually for the purpose of discussing questions of this character. It is manifest that differences between insurance and electrical construction interests are inevitable and that suitable machinery will have to be kept in operation for the equitable solution of these differences.

## A Decision on Negligence.

It is common enough for electric supply corporations to be sued and for allegations of negligence to be made against them, but from all of the litigations has come a wonderfully small body of really definite decisions. In the ordinary course of legal affairs the broad facts of cases are generally lost in a fog of petty legal details. The grand strategy of the cuttlefish is, we are sorry to say, rather popular in legal circles, so that in spite of much litigation clear precedents are scarce. Even the judges show an occasional inclination to side step the broad issues and to take refuge in decisions based on matters relatively trivial. It is, therefore, rather satisfactory to have recorded a decision which actually covers practical issues, even though it may be somewhat distasteful in its bearing. The case reported in our columns by Mr. Ball, although an English precedent, has a direct bearing on questions raised here, so that it must at least be treated with respect. The case was briefly as follows: An electric supply company maintaining an underground distribution, having a fault develop in the cables at an unknown point, attempted to "burn it out" in the manner which is familiar to central station men, even though they do not proclaim their practice from the house tops. As it happened, the result was a severe explosion which ended in the destruction of a building by fire, and a suit for damages. It was held that the method taken of locating or remedying a fault by burning it out constituted negligence on the part of the defendant, and the plaintiff recovered damages.

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In the defence it was shown that under the provisional order upon which the supply company was in business it was compelled to keep up its pressure in the circuits under penalty, and that it could escape the penalty only in case its failure to keep up the supply was due to inevitable accident. In spite of this apparent legal requirement to keep the service going, the finding of negligence in the matter of burning out the fault was made. In our ordinary American practice electric light companies are, as a rule, more free to open temporarily the circuits than under British regulations, although very naturally they dislike to bring down upon themselves the anathema of wrathful customers. Yet the practice of burning out faults is common enough in fact, although generally hidden, as in this English case, behind the ostensible need for keeping up the voltage on the system. If the logic of the Manchester case, oddly enough, against a municipal plant, is transferred to our American courts it behooves electric supply companies to rely on other methods for the localization of faults than the brutally effective one of burning them out. It is really one of the crudities left over from the early days of electric supply—on a plane with tying in the circuit-breakers and fusing cut-outs with wire nails. Every central station man has seen times when he has to take long chances or drop his load, and he has usually, and properly, taken the chances. But faults in underground systems are an expected danger and their occurrence, however unwelcome, must be regarded as one of the natural and commonplace risks for which suitable preparation should be made. Ordinarily a burnout upon an underground system is a risk only to the property of the supply company and involves no public danger; but in a certain proportion of cases risks to both property and life may be produced by such faults, as in this Manchester instance, and in various explosions which have occurred in manholes.

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And right here we think is the logical basis of what otherwise might seem a rather unreasonable decision. The Manchester Corporation was held liable for negligence in the very precautions it took to meet its legal responsibilities of regular current supply, because, if we may venture upon an interpretation, those precautions were of such a nature that they involved the possibility of injury to the persons or property of others without any emergency that could be held to extenuate such an action. We have seen cases where some risk was justified, as in blocking up a circuit-breaker on a railway feeder to avert the chance of power failing on extreme grades where failure might result in a serious accident; but the Manchester instance was not of this sort, and the decision would seem to be a reasonable embodiment of the general doctrine that one may not, without liability, so use his own property as to involve danger to the persons or properties of others. In its practical effect this decision ought to lead to the development of better methods in underground service, just as the sometimes severe requirements or the insurance code have repeatedly led to better and safer practice Central station companies have not infrequently suffered at the hands of juries, but looking at the matter broadly in the light of the history of the art, they have not suffered in vain, for an adverse verdict will often do more to advance current standard of practice than volumes of argument. For example, a few drastic verdicts five years ago would have gone further to spread the salutary practice of grounding the neutral on alternating systems than any amount of protests and resolutions. This is the bright side of a somewhat cheerless subject.

## Boston Meeting of American Electrochemical Society.

The seventh general meeting of the American Electrochemical Society was opened on Tuesday, April 25, in Lowell Hall, Massachusetts Institute of Technology, Boston. The number of members present at the first meeting was about 80. The *esprit du corps* which the society has developed among the electrochemical scientists and engineers of this country was again manifest; and the good feeling which exists in this youngest of our national engineering societies between the practical and theoretical men is very happily illustrated by the way in which the Massachusetts Institute and Harvard University appear alternately on the programme as the hosts of the society. Much credit is due to the social committee, with Dr. W. H. Walker as chairman and Dr. H. P. Talbot as secretary, for their excellent arrangements.

The Tuesday session was entirely devoted to the reading and discussion of papers. The president, Dr. Henry S. Carhart, called the meeting to order.

REVERSIBLE AND IRREVERSIBLE ELECTROLYTIC POLARIZATION.

The first paper presented had Prof. W. S. Franklin and Mr. L. A. Freudenberger as authors, the subject being the exact classification of the various items which make up what is usually called "polarization" of an electrochemical apparatus. The problem was discussed on the basis of the principles of thermodynamics, special attention being paid to the question of the reversibility of the reactions involved. The work spent in forcing a current through an electrolytic cell consists mainly of three parts. First, the heat which appears as Joulean heat throughout the electrolyte. Second, the work which appears as heat at the electrodes on account of the irreversible processes which take place when the ions are deposited. Third, the work corresponding to the chemical decomposition of the electrolyte. In an exactly analogous way the e.m.f. required to force the current through the cell may, of course, also be considered as the sum of three different e.m.f's. The first of these three is the e.m.f. consumed by ohmic resistance. The sum of the two others is the e.m.f. of polarization. How far the reactions corresponding to the latter are reversible or not is the main subject of the paper. This question is intimately connected with Caspari's theory of overvoltage. However, the facts of the existence of an "overvoltage" are not a decisive argument for the irreversibility The authors have studied experimentally rapid electrolysis from this point of view and their results appear to prove that at least some of the reactions are distinctly irreversible.

The paper was discussed at some length by Mr. Carl Hering, who emphasized the ambiguity of the usual definitions of polarization.

THE ALUMINUM ELECTROLYTIC CONDENSER.

A paper on this subject was presented by Mr. C. J. Zimmerman, who had presented a preliminary paper at a former meeting. In the present paper the author first gave hydraulic analogies of the aluminum condenser, and then dealt with the resistance, dielectric strength and inductivity of the film on the aluminum anode; their numerical values were shown to be as high, or higher, than with ordinary dielectrics. The resistance in one instance was given as $10^{11}$ ohms per cubic centimeter. About 5,000,000 volts per centimeter were given for the dielectric strength. The author then analyzed graphically the cell losses and gave a very full graphical and analytical treatment of unsymmetrical cells consisting of aluminum electrodes having films of different electrostatic capacities. He also discussed polyphase electrolytic condensers.

The paper was discussed in a very complimentary way in a written discussion of Mr. Mott.

ECONOMIC TEMPERATURE FOR COPPER REFINING.

A paper on this subject by Prof. C. F. Burgess was then presented, the object being to show an error in Prof. Bancroft's paper presented last year on the same subject. The author emphasized the importance of what Gore calls "transfer resistance" and showed that on this account Dr. Bancroft's results with his small-size cell experiments cannot be directly applied to cells of the size in industrial refineries. On a large scale the results may be quite different from those found by Bancroft on a small scale.

The paper was discussed by Messrs. Franklin, Lidbury, Hering and Thompson.

A DIAPHRAGM CELL FOR ELECTROLYSIS OF SODIUM CHLORIDE SOLUTIONS.

Mr. C. P. Townsend described his newly invented cell for the production of caustic soda and chlorine. This cell was recently described and illustrated in our columns under "Recent Electrochemical Developments." This reference, therefore, may suffice.

ELECTROLYTIC CONDUCTION.

In a paper on this subject Dr. J. W. Richards discussed the electric conduction in molten and solid electrolytes and advocated the thesis that the function of the electric current is the production of new phases at the electrodes and that the diffusion of the nearly formed phases into the electrolyte accounts for the phenomena of ionic migration. Some objections to this view were raised by Dr. Franklin, Dr. Whitney and Dr. T. W. Richards. Mr. Zimmerman gave some interesting notes on the nature of the conduction through Nernst Lamp filaments. They behave partly like electrolytes, and on the other hand there are distant signs of a form of conduction, analogous to the conduction through gases.

ABSOLUTE POTENTIALS.

The last paper of the session of Tuesday was presented by Dr. H. M. Goodwin on Billitzer's method of determining absolute potentials. It will be remembered that Billitzer had obtained results which very greatly disagreed with the usually accepted value of the absolute e.m.f. of the calomel standard electrode. Dr. Goodwin's investigation shows that Billitzer's results are not decisive.

There was a fine exhibit by Messrs. Eimer & Amend, of New York, of various electrochemical apparatus, and especially of electric furnaces using the resistance material "Kryptol."

After the meeting President Pritchett, of the Massachusetts Institute, received the members of the society at the Technology Club, where a lunch was tendered by the Institute. On the afternoon an excursion was made to the General Electric Company's plant at Lynn.

The report of the other sessions will appear next week.

## Meeting of National Conference on Underwriters' Rules.

The meeting of the National Conference on Standard Rules, held at Boston on April 21, was largely attended, the only absence being that of one delegate who was prevented from being present by sudden illness.

The principal business before the conference related to the notice on the fly-leaf of the National Electrical Code relative to the approval of the Code by the conference and the endorsement of the national organizations which its members represent. While this notice was accurate in its application to the first code of 1897, which was drawn by the conference as a result of the meeting of March, 1896, and the subsequent sessions of the Committee on Code, yet there have been so many alterations and amendments added by the electrical committee acting for the National Board of Fire Underwriters that over half of the Code in its present form has never received any action by the conference or the organizations it represents, either by way of endorsement or otherwise.

In the desire that the notice on the fly-leaf of the Electrical Code should be strictly accurate, the conference voted that in its place there should be an historical statement to the effect that the current edition is based upon the Code drawn by the conference of 1896 with the various amendments, and additions which had been made on behalf of the National Board of Fire Underwriters since that time, this notice to be followed by the names of the national organizations represented actively in the conference, namely, the American Institute of Electrical Engineers, National Electric Light Association, Association of Edison Illuminating Companies, National Electrical Contractors' Association, American Institute of Architects, American Institute of Mining Engineers, American Society of Mechanical Engineers, American Street Railway Association, Associated Factory Mutual Insurance Companies, International Association of Municipal Electricians, International Association of Fire Engineers, National Board of Fire Underwriters and Underwriters' National Electric Association.

While under the proposed statement none of the above organizations nor the conference as a whole can be held responsible for rules which they have not approved, yet it will be an advantage to the electric interests and the underwriters to continue to have the co-operation of the expert service of the members of these organizations of electrical and technical societies who are associated with the technical insurance specialists in the conference.

This relation has been still further strengthened by an arrangement made at this meeting, providing for the sending of proposed amendments by the secretary of the Electrical Committee of the Underwriters to the secretary of the conference, to be communicated by the latter to the members of the conference in advance of action taken by the Underwriters at their annual meeting. This provides for a consensus of opinion on any subject of rules to be brought before the annual meeting of the Underwriters' electrical committee.

The other matters brought before the conference pertained to details of organization, and a general discussion upon the National Electrical Code, particularly relative to criticisms upon varying practices of electrical inspectors in their action, which it was claimed frequently deviated from the text of the rules. It was stated that the National Board of Fire Underwriters had provided a means of appeal from the action of any inspector.

In addition to the delegates from the national organizations, the manufacturing and operating electrical interests were represented by gentlemen connected with the American Telephone & Telegraph Company, the Boston Edison Electric Illuminating Company, the General Electric Company, the Pacific Coast Power Transmission Association, the Postal Telegraph-Cable Company, the Western Union Telegraph Company, the Westinghouse Electric & Manufacturing Company and the representatives of many operating electric light and power companies, the whole number being about seventy-five.

## Tesla Patent on Wireless Transmission of Electrical Signals.

A patent issued April 18 to Mr. Nikola Tesla was briefly noticed in these columns last week, the subject being "The Art of Transmitting Electrical Energy Through the Natural Mediums." Below is given a fuller account of the patent.

In the preamble it is stated that experiments and observations have tended to confirm the opinion held by the majority of scientific men, that the earth, owing to its immense extent, does not behave in the manner of a conductor of limited dimensions with respect to electrical disturbances, but much like a vast reservoir or ocean, which, while it may be locally disturbed by commotion of some kind, remains unresponsive and quiescent in a large part or as a whole. The inventor states he has discovered that notwithstanding its vast dimensions and contrary to all observations heretofore made, the terrestrial globe may in a large part or as a whole behave toward disturbances impressed upon it in the same manner as a conductor of limited size.

In the course of certain investigations he noted unsuspected behavior of sensitive instruments, which he discovered to be due to the character of electrical waves produced in the earth by lightning discharges, and which had nodal regions following at definite distances the shifting source of the disturbances. From data obtained in a large number of observations on a maxima and minima of these waves, their length was found to vary approximately from 25 to 70 meters, and these results and certain theoretical deductions led to the conclusion that waves of this kind may be propagated in all directions over the globe, and that they may be of still more widely differing lengths, the extreme limit being imposed by the physical dimensions and properties of the earth. By means of gradual improvements in the generation of electrical oscillations, electrical movements were finally reached not only approximating, but, as shown in many comparative tests and measurements, actually surpassing those of lightning discharges; and by means of this apparatus it was found possible to reproduce whenever desired phenomena in the earth the same or similar to those due to such discharges.

For example, by the use of such a generator of stationary waves and receiving apparatus properly placed and adjusted in any other locality, however remote, it is practicable to transmit intelligible signals or to control or actuate at will any one or all of such apparatus for many other important and valuable purposes, as for indicating wherever desired the correct time of an observatory, or for ascertaining the relative position of a body or distance of the same with reference to a given point, or for determining the course of a moving object, such as a vessel at sea, the distance traversed by the same or its speed, or for producing many other useful effects at a distance dependent on the intensity, wave length, direction or velocity of movement, or other feature or property of disturbances of this character.

In the accompanying figure is represented diagrammatically the generator which produces stationary waves in the earth, and an apparatus situated in a remote locality for recording the effects of these waves. The generator consists of a primary coil forming part of a transformer and consisting generally of a few turns of a stout cable of inappreciable resistance, the ends of which are connected to the terminals of a source of powerful electrical oscillations, this generally being a condenser charged to a high potential and discharged in rapid succession through the primary. *C* is a spiral-wound secondary coil within the primary, one end being connected

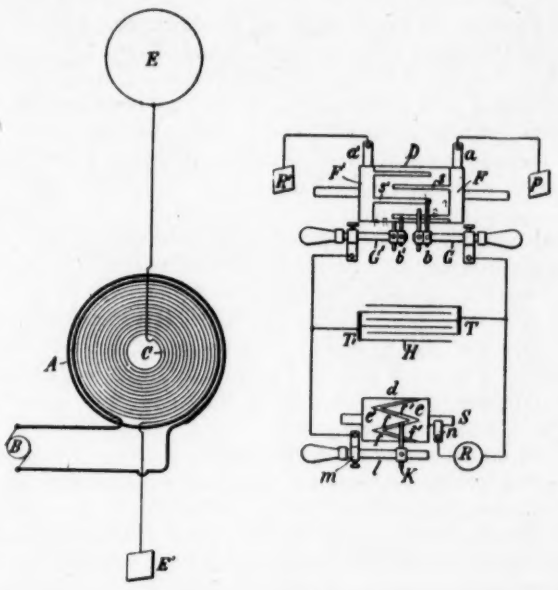



DIAGRAM OF TESLA WIRELESS SIGNAL APPARATUS.

to ground and the other to an elevated terminal, *E*. The resistance of the secondary system should be as small as practicable, its self induction as large as possible and the ground should be made with great care. The total length of the conductor from the ground plate to the elevator terminal *E*, should be equal to ¼ of the wave length of the electrical disturbance or to that length multiplied by an odd number. This relation being observed, the terminal *E* will be made to coincide with the points of maxima pressure in the secondary or excited circuit and the greatest flow of electricity will take place in the same to permit free oscillation. The inductive connection between the primary and secondary should not be very intimate as in ordinary transformers, and this is accomplished by the spiral form given to coil *C*. With this arrangement it has been possible to produce an electrical movement thousands of times greater than the initial, and activity of rates of flow have been produced measured by many tens of thousands of horse power. The powerful electrical oscillations being communicated to the ground cause corresponding vibrations to be propagated to distant parts of the globe, whence they are reflected and by interference with the outgoing vibrations produce stationary waves, the crests and hollows of which lie in parallel circles, relative to which the ground plate may be considered to be the pole. That is to say, the terrestrial conductor is tuned into resonance with the oscillations impressed upon it, just like a wire. A number of facts ascertained clearly show that the movements of electricity through the system follow certain laws with merely mathematical rigor. For the present it is sufficient to state that the planet behaves like a perfectly smooth or polished conductor of inappreciable resistance, with capacity and self-induction uniformly distributed along the axis of symmetry of wave propagation and transmitting slow electrical oscillations without sensible distortion and attenuation.

Three additional requirements seem to be essential to the establishment of the resonant condition as follows: First, the earth's diameter passing through the pole should be an odd multiple

of the quarter wave length—that is, of the ratio between the velocity of light and four times the frequency of the currents; second, the frequency should be smaller than 20,000 per second. The lowest frequency would appear to be 6 per second, in which case there will be but one load at or near the ground plate, and, paradoxical as it may seem, the effect will increase with the distance and will be greatest in a region diametrically opposite the transmitter. With oscillations still slower, the earth, strictly speaking, will not resonate, but simply acts as a capacity, and the variations of potential will be more or less uniform over its entire surface; third, the main essential requirement is that, irrespective of frequency, the wave train will continue for a certain interval of time, which is estimated at not less than 1-12 or 0.08484 of a second, and which is taken in passing to and returning from the region diametrically opposite the pole over the earth's surface with a mean velocity of about 471,240 kilo meters per second.

Fig. 2 shows a device for detecting the presence of the waves. It consists of a cylinder $D$ of insulating material, which is moved at a uniform rate of speed by clock-work or other suitable motor power, and is provided with two metal rings, $F$ $F'$ upon which bear brushes $A$ $A'$ connected to terminal plates. From the rings $F$ $F'$ extend narrow metallic segments $S$ $S'$, which by rotation of the cylinder $D$ are brought alternately into contact with double brushes $b$ $b'$ carried by and in contact with conducting holders, $H$ $H'$, supported in the metal bearings, $G$ $G'$. The latter are connected to the terminals $T$ $T'$ of a condenser $H$, and are capable of angular displacement as ordinary brush supports. The object of two brushes in the holder is to vary at will the duration of the electrical contact with the terminal plates and the condenser. To the latter is connected a receiver $R$ and a device $d$ performing the duty of closing the receiving circuit at predetermined intervals of time and charging the stored energy through the receiver.

The receiver consists of a cylinder made partly of conducting and partly of insulating material which is rotated at a desired rate of speed by any suitable means. The conducting part $e$ is in electrical connection with the shaft $S$, upon which slides a brush $K$ capable of longitudinal adjustment in the metallic support $m$. Another brush $n$ is arranged to bear upon a shaft $S$. It will be seen that whenever one of the segments $F'$ comes in contact with the brush $K$, the circuit including the receiver $R$ is completed and the condenser discharged through the same. By suitable adjustment the circuit may be made to open and close in rapid succession and remain open or closed during such intervals of time as may be necessary.

The terminal plates $P$ $P'$, through which the electrical energy is conveyed to the brushes $A$ $A'$, may be at a considerable distance from each other in the ground or one in the ground and the other in the air, preferably at some height. In the latter case the location of the apparatus must be determined with reference to the position of the stationary waves. If both plates be connected to earth, the points of connection must be selected with reference to the differences of potential which it is desired to secure. In receiving, the speed of rotation of the cylinder $D$ is varied until it is in synchronism with the alternate impulses of the distant generator; the brushes being properly adjusted electrical charges of the same sign will be conveyed to each of the terminals of the condenser and with each fresh impulse it will be charged to a higher potential. In this manner the energy of any number of separate impulses may be accumulated and discharged through the receiver $R$. Thus a relatively great amount of energy may be accumulated and the receiver need not be very sensitive. It being possible to shift the nodal and ventral regions of the waves at will from the sending station, the regions of maximum and minimum effect may be made to coincide with any receiving station or stations.

By impressing upon the earth two or more oscillations of different wave length, a resonant stationary wave may be made to travel slowly over the globe. If the nodal and ventral regions are maintained in a fixed position, the speed of a vessel carrying receiving apparatus may be exactly computed from observations of the maximum and minimum regions successively traversed. In any region at the surface the wave length can be ascertained from certain rules of geometry and conversely, knowing the wave length, the distance from the source can be readily calculated. Thus the distance of one point from another, the altitude and longitude, the hour, etc., may be obtained from the observation of such stationary waves. With several generators, preferably generating different wave lengths, installed in selected localities, the entire globe could be sub-divided in different zones of electrical activity and important data could be at once obtained by similar calculations or readings from suitably graduated instruments.

## Dinner in London to Mr. T. C. Martin.

One of the pleasant echoes of the visit of the British Institution of Electrical Engineers to the States was the complimentary dinner tendered to Mr. T. C. Martin at the Café Royal, London, on the evening of April 8.

When it became known that Mr. Martin was on his way to England, a committee under the chairmanship of Mr. Robert Kaye Gray, past president of the Institution of Electrical Engineers, was formed, and a circular issued inviting all those who had taken part in the St. Louis trip to join in entertaining Mr. Martin at dinner, as a mark of appreciation of that gentleman's many efforts in the entertainment of British visitors to the United States; a number of Mr. Martin's other British and American friends in London, and the press, were also bidden to join in the welcome. The result was that forty gentlemen sat down to dinner, which was presided over by Mr. Gray, a number of those present traveling several hundred miles to do Mr. Martin honor.

After duly honoring the toasts of "The King," and "The President of the United States," the chairman proposed Mr. Martin's health, the toast being supported by Prof. Ayrton. Mr. Martin responded in his usual happy style, dwelling on the fact that it had always been among his greatest pleasures to welcome his own countrymen as well as other foreigners who came to the shores of the United States; and he expressed the hope that it might be his privilege and pleasure to entertain many more such visitors, in the years to come.

The toast, "The Sister Institutions," was proposed by Colonel Crompton, supported by Prof. Perry, and responded to by Mr. Alexander Siemens, president of the Institution of Electrical Engineers, the remarks of all the speakers embodying sentiments of appreciation of American electrical engineers and their work.

The affair was voted an unqualified success by all who attended. Among those present, besides those mentioned above, were the following: Messrs. J. Gavey, W. M. Mordey, Dr. R. M. Walmsley, Prof. J. W. Cormack, A. A. C. Swinton, M. J. E. Tilney, J. E. Kingsbury, J. S. Raworth, A. H. Preece, J. S. Highfield, Fred H. Nalder, H. Laws Webb, G. C. Lloyd, F. C. Raphael, E. H. Johnson, C. J. H. Biggs, R. W. Blackwell, G. L. Addenbrooke, F. W. Martin, H. E. Harrison, H. Alabaster, T. E. Gatehouse, Joseph Wetzler and A. C. Shaw. A number of letters and telegrams of regret were received, among them one from Mr. Marconi.

## Motors for Driving Machine Tools.

At the convention of the National Machine Tool Builders' Association, held in Washington on April 11 and 12, there was presented by Mr. G. Herbert Condit an interesting paper discussing the application of individual variable-speed motors for the driving of machine tools. It was pointed out that in the case of equipping a new shop a saving could be made in the initial cost of the power plant, owing to the fact that there will be less loss in the transmission of the power from the engine shaft to the shaft of the tool, and, therefore, a smaller power plant would be required. With the belt drive it had been practically demonstrated that the average loss in shafting and belting amounts to at least 50 per cent of the total power developed by the engine. This is due especially to the fact that when a belt is laced it is made as tight as possible, in order to provide for stretching, and this results in loss of power from friction in the bearings as well as from the running of the belt itself. After the belts have run for some time they become loose and there is a loss of power on account of the slipping. In the case of the line shafting itself, no matter how carefully the line may be put up in the first place, there will shortly be a certain amount of distortion, especially in a long and heavy shaft, which in time will cause a great loss in the bearings even if they are well lubricated.

In the electrical transmission, assuming that the shop is to be operated at, say, 75 per cent. of the generator capacity, so that a good efficiency can be obtained from the generator itself, the loss between the engine shaft and the line will be about 6 per cent, the line loss 2 per cent and an average loss in the motor itself of 17 per

cent, a loss between the motor shaft and the shaft of the tool itself, where a single pair of gears or a chain drive is used of 5 per cent, or a total loss between the engine shaft and the tool shaft of about 28 per cent. Attention was called to the fact that the loss in the shafting and belting is practically a constant loss no matter whether the shop is operated at its full capacity or not, while the loss in the case of the electrical transmission varies practically with the power used.

As to the difference in cost of maintenance of the motor drive and belt drive, there is no question that the former will show a greater saving over the latter, as in the case of the electrical drive the cost of maintenance is comparatively small, assuming that the electrical apparatus is made according to the most advanced methods of designs and skill which are in vogue at the present time. This is particularly the case in electrical machines using ball bearings, owing to the fact that a guarantee of ten years can be obtained on these bearings from the manufacturer.

Attention was called to the celerity with which speeds of the tool can be changed, and also to the fact that very much greater variations of speed can be secured, so that the tool can be run at the rate most advantageous for any given work. There is also less opportunity for accident to men and equipment, owing to the fact that there are no belts to throw on and off. In this connection the saving in time was referred to because in the case of the electrical change it is only necessary to turn a handwheel or lever instead of throwing a belt from one pulley to another. Assuming that the generating plant furnishing the power is built on up-to-date methods, so that a spare unit is available, there is practically no liability of a shutdown on account of a hot bearing or breakage in any part of the equipment.

Attention was called to the fact that in the conventions held by the electric power and lighting interest, no reference is now made to the belt driving of electric generators, as no designer of a modern plant would consider anything but a direct connected unit. The statement was made that in all probability the equipment of the shop by shafting and belting will not be considered by future conventions of the Machine Tool Builders' Association, as there seems to be a desire on the part of both the machine shop men and the builders of machine tools to equip all tools, no matter of what capacity, with the individual-motor drive.

## The Telephone in Government Service.

The New York *Evening Post,* in a recent issue, printed a dispatch from its Washington correspondent referring to the many things that Uncle Sam does for his people, besides governing them. The telephone is widely employed by the government to help the people, the Agricultural Department being the greatest user of it for this purpose. Through the Weather Bureau it is now distributing forecasts and special storm warnings to practically everybody in the United States. Recently it has been perfecting arrangements with the telephone trunk lines by which the daily morning forecasts are made available for the use of thousands of persons who heretofore were compelled to depend on the bulletins posted at post offices and in railway stations. With the growth of the rural telephone it is expected that, eventually, almost every American farmer will receive the daily weather bulletin in his own home before noon of the day it is issued. In some localities in Indiana, Ohio, Illinois and Pennsylvania the system of distribution has already been perfected to the point where every subscriber of a telephone company receives the day's forecast as early as noon.

Postal officials are confident that the day is not far distant when the rural telephone will become an important factor in the delivery of "hurry-up" letters. Congress has thus far declined to recognize the telephone system as a part of the postal machinery; but, notwithstanding its refusal, the telephone is being brought into use daily in many rural communities by farmers who cannot even wait for the rural carrier. Senator Fairbanks planned to have Congress authorize the use of the telephone in the delivery of special letters addressed to country districts. He proposed that a special stamp should be printed, sold for ten cents, and that when a postmaster received a letter bearing one of these stamps he should open it, reading its contents over the telephone to the farmer to whom the communication was addressed.

Some of the Senators objected to this plan because they feared it might commit the government to a policy that would compel it to pay large annual rentals to telephone companies. But many men in the postal establishment say the new step is coming. Indeed, it is already here unofficially. By securing permission from the department a rural postmaster may now arrange with his patrons out in the country to open their letters and read the contents to them over the telephone, and farmers who have city interests that demand careful watching are making use of the permission. Congress may give its sanction to such duties at its next session.

## CURRENT NEWS AND NOTES.

*CABLE CHESS MATCH.*—By the recent breaking of one of the Western Union transatlantic cables that company announced its inability to fulfill its contract regarding the ninth international cable chess match, which was to have begun April 14.

*WIRELESS FOR GUAM AND HONOLULU.*—The United States Navy transport *Solace* will take, on her next trip from San Francisco, two sets of Lodge-Muirhead wireless telegraph apparatus. One set will be installed at Honolulu, and the other at Guam, under the direction of the Navy Department.

*WARD LEONARD LOCOMOTIVE IN SWITZERLAND.*—The Ward Leonard locomotive built by the Oerlikon Works for experimental purposes is now in regular service on the line constructed by this company to test questions relating to heavy electric traction. The control incident to the Ward Leonard system has, it is stated, been found ideal. There is an entire absence of sparking and mechanical brakes can be dispensed with.

*WIRELESS FOR SABLE ISLAND.*—The Canadian Government has decided to install wireless telegraph equipment on Sable Island and on Chebucto Head at the entrance of Halifax harbor. Hitherto news from Sable Island has been brought to the mainland four or five times a year by steamer, and reports, especially of vessels wrecked, often have been greatly delayed. The distance from the nearest point of the mainland to the island is 100 miles.

*FIRST PATENT IN CHINA.*—The Chinese Government, according to German papers, has granted its first patent. It is for an electric lamp, the inventor of which is an inhabitant of Nanking, the old capital of the Chinese Empire, who calls his lamp the "bright moonlight," and asserts that it is far superior to foreign glow lights that hitherto have been sold at Shanghai and other Chinese cities. It is significant that the first officially recorded Chinese invention has electricity for its subject.

*WIRELESS TELEGRAPHY AND ICEBERGS.*—One of the most important uses of wireless telegraphy between ships at sea is in apprising one another of danger. The steamer *Kaiser Wilhelm II,* on her last voyage to New York, was apprehended by the announcement from the *Teutonic,* 60 miles away, that there were nine icebergs in the direct path of the *Kaiser.* The *Teutonic* further announced that a message had been received from the *Caronia,* of the Cunard Line, that there were 40 bergs farther along the course. Thus warned, the *Kaiser* slowed down and next day she was engaged in dodging the apparitions.

*INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS.*—The tenth annual convention of the International Association of Municipal Electricians will be held at Erie, Pa., August 29, 30 and 31, 1905. For this meeting the following programme of papers has been prepared: "Electrical Induction, Its Effects and the Application of Methods Used to Counteract It"; "Advisability or Inadvisability of Fusing Fire and Police Telegraph Boxes"; "Suggested Improvements in Fire Alarm Telegraphs"; "Underground Construction"; "The Necessity of a Rigid Inspection by the Municipality"; "Electric Light Engineering"; "Electric Light Plants." These papers have been assigned to men thoroughly conversant with the subjects. The papers that have been presented in the past are available to all members, and cover almost the entire field of the city electrician or superintendent of fire or police telegraph. Mr. Frank P. Foster, Corning, N. Y., is secretary of the association.

*NEW YORK CITY LIGHTING RATES.*—According to the New York *Herald*, the Stevens legislative committee, which has recently been investigating the gas and electric light companies of Greater New York, will recommend a maximum rate of 10 cents per kw-hour for electric lighting current and 75 cents per thousand cubic feet for gas.

*ELECTRIC LOCOMOTIVE'S HIGH SPEED.*—A dispatch from Schenectady, N. Y., states that the electric locomotive, recently built for the New York Central's terminal service at New York, attained a speed of 83 miles per hour April 25. The test was made for the benefit of several visiting railroad officials. A heavy train was hauled by the locomotive on this test.

*MILAN-SIMPLON EXPOSITION.*—A high-tension, single-phase railway will be constructed to connect distant parts of the grounds of the Milan-Simplon Exposition, which will be held next year. The line will be elevated, double-tracked and about 4,500 ft. long. Four four-car trains will be run, each accommodating 260 passengers. The multiple-control Finzi single-phase system will be employed.

*MUNICIPAL TAXES IN ENGLAND.*—The London *Daily Mail* has been printing communications concerning the increasing burden of taxes due to the operation by municipalities of various public utility plants. Owing to the great increase in taxes rents have correspondingly gone up, with the result that the number of vacant houses is rapidly increasing and the value of property decreasing. One correspondent states that taxes are becoming almost a rent in themselves, now nearing half the rent.

*TRANS-CONTINENTAL TELEPHONES.*—Another step in the direction of rendering possible continental communication by telephone is now being prepared by the Austrian Government. The Minister of Commerce of Austria has notified the Lieutenant-Governor of the Tyrol that in September next direct telephonic communication between Vienna and Trent will be an accomplished fact. As Trent is only about 44 miles from Verona, the day of direct telephoning between Rome and Berlin is probably not far distant.

*EARLY CABLE INSULATION.*—The death recently in London of Mr. Edwin Truman, a dentist, recalls the early history of cable telegraphy. The first Atlantic cable in 1858 failed owing to lack of proper insulation. Mr. Truman discovered that gutta percha could be so thoroughly purified as to make it the proper material for the insulating covering of the conductor. He disposed of the patent of his discovery to the Gutta Percha Company, which made the cable for the Atlantic Telegraph Company, with the result that cables subsequently laid have been covered with gutta percha purified by Mr. Truman's process.

*NATIONAL ELECTRIC LIGHT CONVENTION.*—Mr. George F. Porter, master of transportation for the National Electric Light Association, has appointed Mr. Charles H. Hodskinson, of the Boston Edison Company, to look after transportation matters in New England in connection with the coming convention at Denver-Colorado Springs, June 6 to 11. Those in attendance at the Boston convention last year will remember Mr. Hodskinson's untiring and efficient work in every direction, so they will not be surprised if he succeeds in taking to the Colorado meeting a large contingent of New England electrical men.

*SELF-INDUCTIVE MOTOR-STARTER.*—An automatic starter for direct-current motors, which utilizes the counteractive effects of changing currents, forms the subject of a patent granted April 18 to Mr. A. C. Eastwood. Instead of an automatic or manually-operated rheostat, there is connected in series with the armature a coil of low resistance, but high inductance. It is the intention that the e.m.f. counter-generated by the change of the current in the inductance coil will decrease, while the e.m.f. counter-generated by the speed of the motor will increase so that the motor may be made to start smoothly and with a safe current. Across the armature of the motor is connected the operating coil of a circuit-closing device, which is arranged to short-circuit the inductance coil when the counter e.m.f. of the armature reaches a predetermined value. It would be interesting to learn the value of the time-constant of the inductance coil, and with what rate the armature is required to accelerate in practice.

*ELECTRIC HEATER.*—A patent issued April 18 to Mr. L. E. Barringer has for its object to provide an improved substitute for enamel in electric heaters. Experience shows that when enamel is subjected to a dull red heat it loses its insulating properties and becomes slightly conducting. Under these circumstances also it may cease to act as a spacer between the conductor and its supports, and by reason of its more or less fluid condition may permit the conductor to come in contact with the supporting metal plate. The present inventor uses a mixture of enamel and crushed quartz rock. The quartz rock has a fusing point at about 1,800° C., while the enamel has a fusing point ranging between 625° and 1,100° C. In assembling the parts, the metal plate is first covered with a layer of enamel in the powdered form and subjected to heat as is usual in the enameling of metal ware. The enamel coating, when cool, is then covered with crushed quartz rock, and again fused, thereby causing the particles to be held firmly in place. The electrical conductor rests directly upon the layer of particles, and is out of contact with the enamel coating.

*ENGLISH UNDERGROUND TELEGRAPH CABLES.*—The British Post Office Department has laid from London to Carlisle an underground telegraph cable which next year will be extended to Glasgow. In 1896 the Government entered upon the task of connecting the metropolis and Scotland by means of wires, which should not be subject to interruption in storms. The route was divided into four sections—London to Birmingham, Birmingham to Warrington, Warrington to Carlisle and Carlisle to Glasgow. In 1899 a cable containing 76 wires was laid to Birmingham—a distance of 117¼ miles. The extension to Warrington, over 80 miles of road, followed, and in this cable the number of wires was increased to 103. From Warrington to Carlisle the distance is 114 miles, and the cable contains 97 wires. All the cables are placed in iron pipes which are sunk two feet below the surface of the public roads, examination boxes being constructed at intervals throughout the route. It is stated that in regard to rapid transmission, overhead wires have a distinct advantage over those laid underground, as may be judged from the fact that, for a distance of 400 miles, messages are being dispatched at the rate of 400 words per minute, while the highest speed reached over an equal distance by underground wires is 200 words.

*BARCLAY PRINTING TELEGRAPH.*—In our issue of April 1 last we gave a brief description of the printing telegraph system of Mr. J. C. Barclay, assistant general manager and electrical engineer of the Western Union Telegraph Company, now in practical operation between New York and Buffalo. This article was based upon patents issued to Mr. Barclay March 21. On April 18 another patent was issued to Mr. Barclay covering the printing and selecting mechanism of the system. The power for moving the type wheel to the printing point and for making the impression is supplied by a constantly rotating shaft driven by an electric motor located within the frame of the machine, the determination of the particular character from which the impression is to be taken being effected under the control of electrical selecting mechanism capable of operating with extreme rapidity and requiring a minimum of power for their operation. The carriage moves in both directions, as in the ordinary typewriter, the feed and return movements being controlled by electromagnets are entirely automatic. The paper feed is also controlled in a like manner. On the type wheel are two rows or bands of characters, normally the upper band being in printing position. The spindle of the wheel is capable of longitudinal movement within its support, as well as rotative movement, in order to bring the lower band of characters into printing position, this being accomplished by a magnet under the control of the selecting mechanism. The selecting mechanism, as was briefly described in our former article, is operated by successive current impulses, which are of the same number for each character but of varying lengths, the different characters being differentiated by variations in number and arrangement of dots and dashes. The printing magnet corresponding to each character is selected by the action of primary and secondary selecting relays—a "sunflower" and a separator relay. The patent covers so many details that it is imposible to give, in the small space available, more than a brief outline of the invention. It is accompanied by 15 illustrations.

# A Norwegian Hydro-Electric Plant.

BY T. NORBERG SCHULZ.

AS stated in an article in the issue of ELECTRICAL WORLD AND ENGINEER for February 11, 1905, the municipality of Christiania, Norway, established in 1892 a steam power station in the central part of the city, the town being supplied from this plant with continuous current for power and lighting. The original plant was made for the three-wire continuous-current system with a voltage of 2 × 110. In 1900 this e.m.f. was raised to 2 × 230 volts by an alteration of the machinery of the power station and a reconstruction of the main switchboard. As a consequence of the higher voltage, the installations at the consumers had to be renewed in part.

In 1898 the erecting of a water power plant was started at Hammeren, from where 3,000 hp is transmitted through a distance of about six miles to a sub-station not far from the center of the town.

The sub-station supplies the tramway with electric energy distributed at 580 volts continuous current, and operates in combination with the steam station on the lighting and power circuits. In addition to the water power plant now in use the municipality has purchased three waterfalls in the neighborhood of the city as follows:

Halfredsfos, capacity 11,000 hp., at a distance of.....30 km.
Kaggefos, capacity 6,000 hp., at a distance of.....46 "
Bjornsjfald, capacity 2,000 hp., at a distance of.....15 "

It is the intention to supply the suburbs of the town from these waterfalls, the electrical energy being distributed as three-phase alternating current.

There are given below the calculations made with the intention of solving the economical problems which were raised in connection with the combined operation of the older steam station and the newer water power plant. The point was at first to provide a general view of the relative economical advantages to be obtained

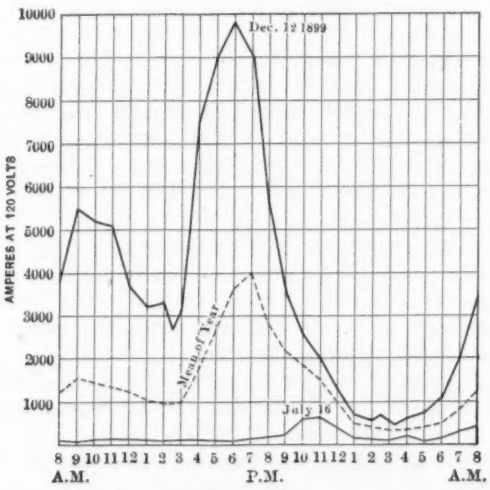



FIG. I.—MEAN DAILY OUTPUT, 1899.

with the new water power plant when operating separately and when working in parallel with the steam plant. The following data served as a basis for these calculations:

| | Max. available kw. including reserves. | Cost per kw. of plant reduced to max. pwr. | Producing expenses annually per max. kw. Without coal. | With coal for 1500 hs. run at full load. |
|---|---|---|---|---|
| Steam station (continuous current 2×230 volts). | 1900 | $150 | $22.00 | $46 |
| Water-power plant (continuous current 2×230 volts) | 1920 | 280 | 33.50 | .. |
| Water-power plant (altern. current at town 5000 volts) | .. | .. | 23.50 | .. |
| Water-power plant (altern. current at hydraulic plant) | .. | .. | 16.00 | .. |
| Storage battery (without building, 4 hours discharging time) | 250 | 160 | 27.00 | .. |

From the above it will be seen that the cost of the steam station and the storage batteries is considerably lower than that of the water power plant, and, accordingly, a certain amount of coal might be used at the steam station, so that the annual producing expenses per kw would become the same for the two plants.

As above stated, the difference in price per kilowatt for the two stations, when continuous current is used, amounts to $11.50 per year. One kw-hour produced at the steam station requires 4 kg. of the best steam coal, the price of which is $5.30 per ton (1,000 kg.) at the station. As a supplement to the water power plant, the steam station might, accordingly, run a total of $\frac{1{,}150}{4 \times 0.53}$, or about 540 hours annually, before the producing expenses exceed those of the water power plant. It is to be noted that the above-mentioned cost

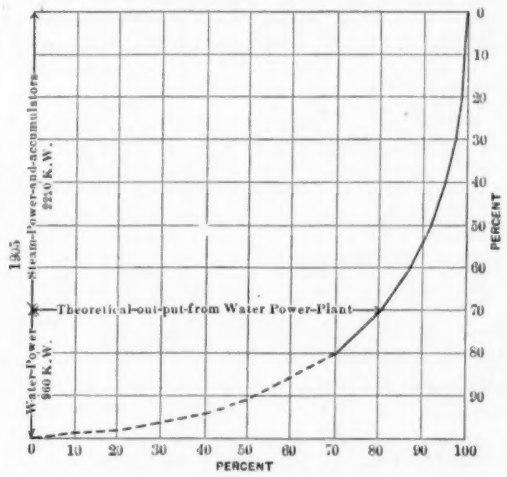



FIG. 2.—OUTPUT CURVE.

includes 5 per cent. interest, 5 per cent depreciation for the steam station and 4 per cent depreciation for the water power plant.

Fig. 1 shows the mean output per day for the year 1899, and the outputs on the days having maximum and minimum loads. From this diagram it will be seen that the maximum load is of a very short duration, and, consequently, the steam plant would have to be run only a few hours per day during the winter months.

From Fig. 2, which is intended to represent graphically the numbers of kilowatt-hours which the steam station will have to produce for various sizes of water power plants and steam stations with storage batteries, it will be seen that steam machinery or storage batteries which are delivering 50 per cent of the full load, measured from the top end of curve, will have to produce only 8 per cent. of the output for the whole year.

Fig. 3 shows the load factor for the supplementary machinery; that is to say, the relation between the real output of this machinery and the theoretical output for 8,760 hours a year at full load. If this machinery be 50 per cent. of the whole machinery, it will be seen that the load factor is only .023.

As mentioned above, a run of 540 hours, as calculated, corre-

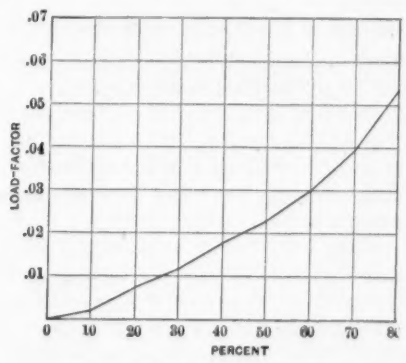



FIG. 3.—LOAD FACTOR CURVE.

sponds to the balance between the steam station and the water power plant. The load factor for the steam station would then be $\frac{540}{8{,}760} = .0616$, which means that, economically considered more than 80 per cent of the total load under the above conditions can be delivered with steam engines. According to this, for economical

proportion the generating plant should consist of 80 per cent steam and 20 per cent hydraulic equipment. These calculations apply to the supply of current for lighting and smaller industries only.

One-half of the water power plant being at present utilized for the traction lines, there is still left about 960 kw, including the spare machinery, which should equalize about 4,000 kw of steam power. As the steam station has about 1,520 kw and the storage batteries about 700 kw for lighting purposes, these plants should theoretically be equipped with considerably more machinery. Other facts with which, however, it would be rather too much to deal in this article, must be reckoned with in this connection.

As a result of these calculations, the steam station and the storage batteries have been considerably extended recently, so that the capacity of the machinery now installed for lighting is as follows:

| | |
|---|---|
| Water-power plant | 960 kw. |
| Steam station | 1520 " |
| Storage batteries | 700 " |
| | 3180 " |

The maximum load in 1904 occurred on December 2, making 2,000.5 kw. The total output for the year amounted to the following:

| | |
|---|---|
| From the water-power plant | 2,979,050 kw-hours. |
| From the steam station | 49,413 " " |
| From the storage batteries | 290,628 " " |
| | 3,319,091 kw. hours. |

The water power plant has, therefore, delivered 89.75 per cent of the total output. This proportion will be lowered toward about 80 per cent (see Fig. 2) as the load on the stations increases, and the steam station must aid in the production.

The storage batteries receive current from the water power plant without entailing any expense for charging. There are now installed two batteries for which the data are as follows:

| Battery. | Cost includ. building. | Capacity in kw. discharged in 4 hrs. | Capacity in kw. discharged in 5 hrs. | Cost per kw. 4 hrs. | Cost per kw. 5 hrs. | Annually expenses. | Annually expen. per kw. 4 hrs. | Annually expen. per kw. 5 hrs. |
|---|---|---|---|---|---|---|---|---|
| No. 1 (in 1892-98.) | $66,200 | 250 | 210 | $264 | $315 | $9000 | $36 | $43 |
| No. 2 (in 1902.) | 61,600 | 430 | 365 | 143 | 166 | 8500 | 20 | 26 |
| | $127,800 | 680 | 575 | $188 | $223 | $17500 | $26 | $30 |

In the annual expenses are included 10 per cent for interest and depreciation.

It will be seen that the use of the larger battery is attended with good economical results. There is, therefore, being erected a new building intended to be equipped with two other storage batteries like No. 2. In addition to the economical results, the supplementary steam station and storage batteries insure a continuity of service.

The economy of the plants has been very satisfactory, giving a net profit of about 13 per cent per year. Only a small part of the town is as yet supplied with electrical energy. The municipality will probably within a short time utilize other sources of power for supplying the manufacturing sections of the town.

## Grinding of High-Speed Commutators.

By O. H. Crossen.

An objection raised against the use of rotary convertors on 60-cycle, alternating-current systems is based on the troubles encountered at the commutator. While the design of the commutator for a low-voltage, 25-cycle converter is comparatively free from difficulty, the problem becomes more complex with increase of either the frequency or the e.m.f. For very high frequencies and voltages, the designer is forced to use an extremely large number of commutator segments, or to accept a high difference of potential between adjacent segments; to use very thin segments or to resort to high peripheral speeds. It is evident that any of these extremes would prove detrimental to the sparkless operation of the commutator, and with 60-cycle rotary converters for railway work a compromise design must be adopted, a large number of thin segments being used upon a commutator having a high peripheral speed.

Even with a commutator of the best construction, sparkless performance will not be obtained unless the bearing surface of the mica and segments be kept perfectly true. Any slight roughness of the surface, due to difference in height of the mica and the segments, will cause under the brush a spark which will burn the segments and thus increase the roughness, so that the effect is cumulative. Continued operation of a roughened surface will soon result in the necessity for the use of a turning tool to prevent the sparking.

The most common method for smoothing a commutator involves the frequent use of sandpaper. The present writer believes this method to be inadequate, since it merely postpones the trouble for a day or two at the most, and it causes the rapid wearing away of the commutator. Experience indicates that it is impossible to obtain good results from the use of sand-paper upon a commutator having a peripheral velocity as high as 4,600 ft. per minute.

Excellent results have been obtained, however, by using the brushes themselves for grinding the commutator. For this purpose the machine should be driven by some external means, as, for example, by the small starting motor on its shaft, and its field circuit should be open, so that no electromotive force is generated at the commutator. A thin film of light engine oil should then be applied to the commutator with a cloth. Within from three to five minutes the surface of the commutator will be ground smooth, due to the cutting of the brushes. The grinding being completed, the oil should be removed, and a little gasoline applied with a cloth to thoroughly clean the commutator and brushes. Care should be exercised to remove all oil from the under side of the brushes, for any oil which finds its way to the commutator during operation is liable to become carbonized and cause trouble.

Commutators may be kept in practically perfect condition, if they are ground in this manner whenever sparking begins to appear. Some commutators will require this treatment after a run of twenty hours, while others need not be ground so frequently.

## Theft of Current: How to Detect, Prosecute and Prevent.—I.

By J. H. Hallberg.

Of the unaccounted-for current lost in the distribution of electric energy by central stations, the greater part can safely be attributed to theft of current. The average central station manager is not in a position to detect losses of current from theft, and comparatively few of the large public service corporations have systems of accounting, testing, inspection and prosecution, so perfect that they can intelligently prevent the theft of current or prosecute the guilty parties.

That the loss in revenue, due to theft of current, is considerable has only recently been appreciated by the average electric lighting corporations. This fact may be due largely to the introduction of "improved systems of accounting" and familiarity with the methods usually employed in "beating the meter," as referred to by Messrs. Walter M. Anthony, L. G. Van Ness and Robert L. Elliott, in their able papers before the 1903 convention of the National Electric Light Association.

Notwithstanding the previous papers and discussions on this subject, a description of methods successfully employed for detection, prosecution and prevention, together with references to specific cases of theft of current, may be of interest.

The manager or general superintendent should look to the following departments for reports and information on which to base investigation of general loss and theft of current: accounting department, meter readers' department, meter department, inspectors' department, lamp renewal department, service and distribution department.

The accounting department should be instructed to report any unusual variations in customer's monthly bills, so that the manager may send an inspector to investigate quietly the condition of the meter and to ascertain whether or not a change has been made in the operation or size of the customer's installation.

The meter readers' department must report any unusual condition of the company's service connection, switches, fuses and meters; all meter readers should be instructed to report suspicious cases at once, and not ask questions on the customer's premises, as it is important that no evidence be destroyed before the inspector arrives as a second witness.

The meter department having charge of the repair, testing and changing of meters, should also report if meters or service connections show that they have been tampered with, and the records of this department should be carefully kept, as they may have to be referred to in case of prosecution of a customer.

The inspectors must be experts on all matters pertaining to the company's distribution system, metering of current and general wiring of buildings, and they should be men selected for their honesty, tact and good judgment. The inspectors can be used to good advantage in dealing with customers who "kick" about their bills and service, and a good inspector is valuable to any company.

The records of the lamp renewal department are of considerable importance to the manager when investigating a possible case of theft of current. There should be kept in this department a system of cards which will indicate the number of lamp renewals, time of exchange, etc., for each customer. Such a card system forms a very good check on the current consumption, and can often be advantageously referred to.

The service department which installs the company's service lines, switches, fuses and meters must report any unusual methods of wiring on the new customer's premises. The distribution department should always be on the lookout for grounds and "taps" on the company's lines, and if anything appears to be out of the ordinary, make note of it for future reference.

Of the employees of the company, those in the above departments are most likely to discover theft of current, and the manager who properly instructs and directs them will find little difficulty in detecting theft of current and much assistance in prosecuting the offender.

Competent legal advice is absolutely necessary in matters of this kind, and no steps should be taken without such advice, as the slightest mistake may prevent conviction. It actually encourages others to steal current, when a company prosecutes a customer for theft of current and fails to convict him.

Practical experience indicates that it is to the company's advantage to have all customers' service connections inspected as often as possible, and for certain classes of customers the examinations should be frequent and unexpected. It is deemed unnecessary to refer here to the particular class of customer whose services should be frequently inspected, as every operating company has a general idea of who they are, but it may be stated that they range anywhere from the smallest saloonkeeper to the largest club, including even the employees of the company.

After a customer is suspected of tampering with his meter and current supply, it is necessary for the company to secure "facts" in regard to how and to what extent he is defrauding the company. Through the efforts of the inspection department, and by secretly installing a duplicate recording wattmeter ("telltale meter") in series with the customer's meter, this information can generally be had.

The following reprints from newspapers in Cincinnati, Ohio, give a good description of the method successfully employed by an electric light company in prosecuting one of its customers for theft of current:

"Billy Eng, a well-known saloonkeeper on Vine Street, near Twelfth, was arrested last evening on a warrant charging him with maliciously tampering with an electric meter. The warrant was sworn out by Attorney Joseph Heintzmann, acting for the Cincinnati Gas & Electric Company. According to Mr. Heintzmann's allegations, Eng has been receiving electricity and paying for about half of it. It is alleged that Eng constructed a sort of screen about the meter, and that the wires were tapped at the switch in the cellar. By means of a "jump" the meter was passed over, and these wires fed the lights in other parts of the house. The meter did only about half of the work that it would have done had the entire current passed through it.

"It is claimed that when the meter reader called Eng would go down into the cellar through a trap-door back of the bar, telling the reader he would be back in a minute. It is further alleged that when he reached the cellar he hid all evidences of the existence of crooked wires. The company suspected that all was not right, and accused him of it. Eng denied that he was doing anything wrong, and asserted that if any of the employees of the company came nosing around his place they would get hurt. The company, however, was determined to catch Eng, and, unknown to him, a telltale meter was put in the cellar of an adjoining business house. It worked like a charm, and showed that Eng was using more electricity than he was paying for. Mr. Heintzmann anticipated trouble when four employees were ordered to the place to shut off both the gas and electricity, and he invoked the aid of the police. Four patrolmen were sent, but Eng quietly submitted to arrest when the warrant was produced. He was released on bond, and last night the big raffle of turkeys, which was advertised to take place there, was carried on by the light of lamps and candles."

After the above item appeared in the *Cincinnati Enquirer,* the company took steps to produce before the Police Court the wiring, meters, switches and cutouts removed from Mr. Eng's cellar, and on December 5 a practical demonstration of how the current was diverted from the meter took place in the Cincinnati Police Court, as indicated in the following newspaper item:

"A practical demonstration with a working model made at a cost of $100 was used by the Cincinnati Gas & Electric Company in the Police Court Friday in the prosecution of William Eng, saloonkeeper, at 1205 Vine Street, on the charge of tampering with an electric meter. The case, as presented by the company experts, caused unusual interest. Eng is charged with having, by a clever contrivance of auxiliary wires, used unknown quantities of electricity in the lighting of his saloon, for which he has never paid. According to the testimony given by J. H. Hallberg, general superintendent of the electrical department of the company, Eng's bill for the first month after the installation of electric lighting in his place was $47.50. From that time on, however, there were decreases in his bill, which finally lowered to $10 for one month. The company began to investigate, with Expert George Healey in charge. Repeated attempts to gain access to the meter in Eng's cellar were frustrated, it is said. Finally Healey discovered hidden in the cellar three wires, with hooks at each end, which were called "straps." These wires, it is alleged, were attached to the current wires before

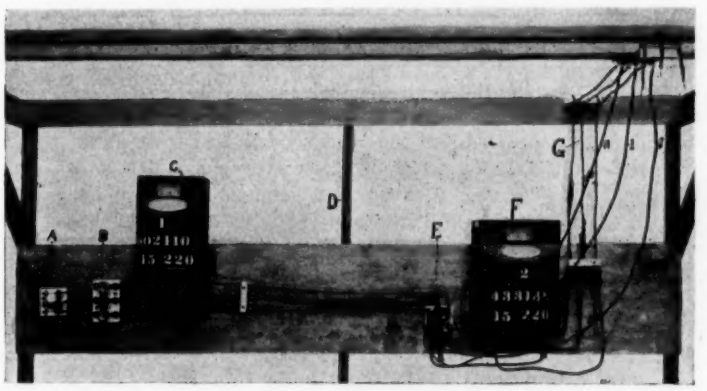



FIG. 1.—MODEL SHOWING USE OF SHUNT CIRCUITS.

entering the meter and carried over to the wires that had passed through the meter. In this way, it is said, the meter was made to register only one-half of the current consumption, and the "straps" could be put on or removed at will. Then the company set to work to construct a model. They stripped the identical wires from Eng's place, showing where insulation had been taken off to make a contact. The same meter and the "straps" were used. But before the arrest was caused the company installed in the cellar adjoining a "telltale" meter, which tapped the wires entering Eng's place. This meter registered twice as much current used as did Eng's, and then the experts considered their case made. For demonstration in the court, wires were strung from a pole at Ninth Street and Central Avenue entering the courtroom through a window, and a battery of forty-five lights was attached. Healey, working the model, and testifying, made clear the contention of the company, and the fine points of electrical knowledge were made known by showing where the "strap" wires had been burned by short-circuits, etc. As a parting blast the expert caused a short circuit, and blew out a set of fuses to show the court a bit of pyrotechnics, not understood by the layman. In the model a counterpart of the two cellars was shown in miniature, but exact distances were observed in the construction of the duplicate of Eng's meter and wires adjacent to it. The model was about 6 by 8 ft. in size. No defense was offered by Attorney Darby for Eng, and he was held to the Grand Jury under a bond of $1,000."

Referring to the foregoing newspaper reprints, attention is called to Fig. 1, which illustrates the model used in the Police Court in Cincinnati in connection with the Eng case.

In Fig. 1, *A* represents the service switch on the Edison three-wire underground system. *B* is the cutout, *C* is the telltale meter, which was installed in the cellar adjoining Mr. Eng's property, and

the partition, *D*, is supposed to indicate the wall separating the two cellars. *E* is Eng's service switch in his cellar, *F* is the regular meter, and *G* the wires which led from the meter to the cut-out cabinet on Eng's premises. *H*, *I* and *J* are the three "straps" which were applied to the service switch terminals and wires leading from the meter to the cutout cabinet, thus shunting the current around the meter.

The demonstration in the Police Court was most thorough and interesting. The covers were removed from the meters, and the current was turned on in the regular way with the "straps" removed. The meters were then observed to rotate in unison, their

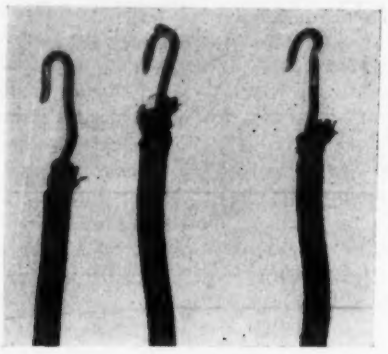


FIG. 2.—ENDS OF SHUNTS.

speed depending upon the number of lamps that were burning. As more lamps were turned on, the speed of both meters would increase, and, as the lamps were turned off, the speeds would decrease, proving beyond a doubt that the meters were correct and were registering the same amount. The "straps" were then attached to switch *E* and to the house wires *G*, as shown in Fig. 1, with the result that the speed of meter *F* was considerably reduced, compared with the speed of meter *C*, and when the switch *E* was opened the meter *F* would stop and the telltale meter *C* would continue to run, indicating, of course, the amount of power that might be used by the customer without registration on his meter.

The porcelain base of switch *E* shows considerable discoloration, due to flashes and momentary short circuits, caused by the application and removal of the "straps" to the switch terminals, and a very strong point was made of this fact by the prosecution.

Fig. 2 illustrates one end of the three straps which were used for short-circuiting the meter in Eng's cellar, and it can plainly be seen

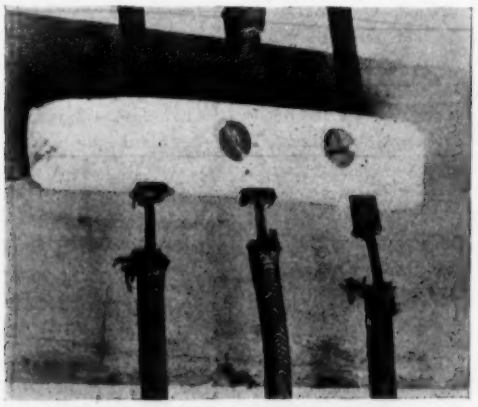


FIG. 3.—POINTS WHERE SHUNTS WERE CONNECTED.

how the copper wires, which are bent in the shape of hooks, have been subjected to arcing, and have consequently become pitted and burned as was observed on the terminal posts of switch *E*, in Fig. 1.

Fig. 3 illustrates the wires, *G*, attached to the ceiling in Eng's cellar, showing where the insulation had been scraped off in order to permit the "straps" to be hooked on. Reference may be made to the pitted and burned condition of the wires in Fig. 3, and also to the insulation on these wires, which had been subjected to very high temperature, undoubtedly due to poor contact between the straps and these wires. The liability of fire from such causes as this is evident, and, in this case, it was surprising that no damage of this kind had been done.

After the company had presented the foregoing strong evidence, together with the bills rendered to Mr. Eng for electric service, Mr. Eng was bound over to the grand jury under a bond of $1,000. The same evidence being presented before the grand jury, Mr. Eng was indicted, as he could not put forth any defence. Unfortunately, the final outcome of this case has not yet been made public, but the moral effect of newspaper items referring to the above proceedings, which practically gave a victory to the company, was all that could be desired.

Unless substantial evidence, similar to that described above,, can be offered in cases of this kind, it would be unwise for a company to attempt prosecution of a customer for theft of current. In a concluding article the subject of prevention of theft of current will be considered in detail.

## The Practical Design of the Solenoid.

BY CHARLES R. UNDERHILL.

ALTHOUGH the solenoid or coil-and-plunger has been in every-day use for a great many years, there are so few data published regarding the practical design, that the writer thinks the following data obtained by him will be of some value to engineers who may have occasion to design this type of electro-magnet.

The solenoid as commonly made consists essentially of the winding of helices of right and left pitch, and the supporting ends, as shown in Fig. 1. The core or plunger shown in the cut is drawn inside the solenoid when a current is passed through the winding, and it is the law controlling this action which forms the text of this article.

The core or plunger usually consists of a round rod of soft iron, and as it enters the field of the solenoid it is slightly magnetized, and mutual attraction results between the plunger and the field of the solenoid, and if the coil be stationary, and the plunger be

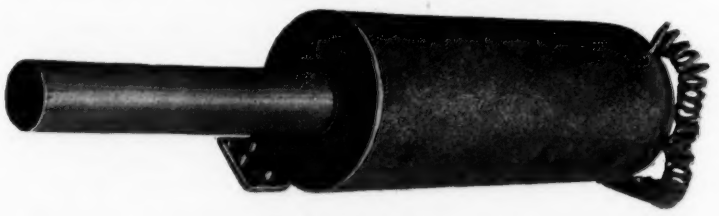


FIG. 1.—SOLENOID.

free to move, the plunger will be drawn further in, this action decreasing the reluctance of the magnetic circuit by reason of the iron introduced in the field, and the flux in the iron will, therefore, be greatly increased, until the centre of the coil is at the neutral point of the plunger, when the attraction and repulsion will be equal.

Where the plunger is of the same length as the exciting coil, the ends of the plunger will be flush with the ends of the coil when at rest, but where the plunger is much longer, say twice as long as the coil, the attraction practically ceases when the end of the plunger has protruded a short distance from the end of the coil. The reason for this is that the return circuit is not from the extreme ends of the plunger, but from the entire projecting portion of the plunger, similar to the second cut in Fig. 2. Therefore, what may be termed the apparent south-seeking pole of the plunger, will be at the same distance from the end of the coil as the north-seeking pole is from the other end of the coil.

In the case of a winding whose diameter is great as compared with its length, the pull is greater after the plunger has protruded a short distance beyond the end of the winding. Solenoids commonly used in practice are greater in length than in diameter. It is the action of this latter type of solenoids which will be described in detail.

The range of a solenoid is the distance through which its plunger will perform work when the winding is energized. The greater the length of the solenoid, the greater will be the range, as the range varies in nearly direct proportion with the length of the solenoid. The range of the solenoid is constant regardless of the ampere-turns, but the attraction or pull on the plunger varies directly with the ampere-turns after the core is saturated, there being some variation below this point due to change in the permeability of the

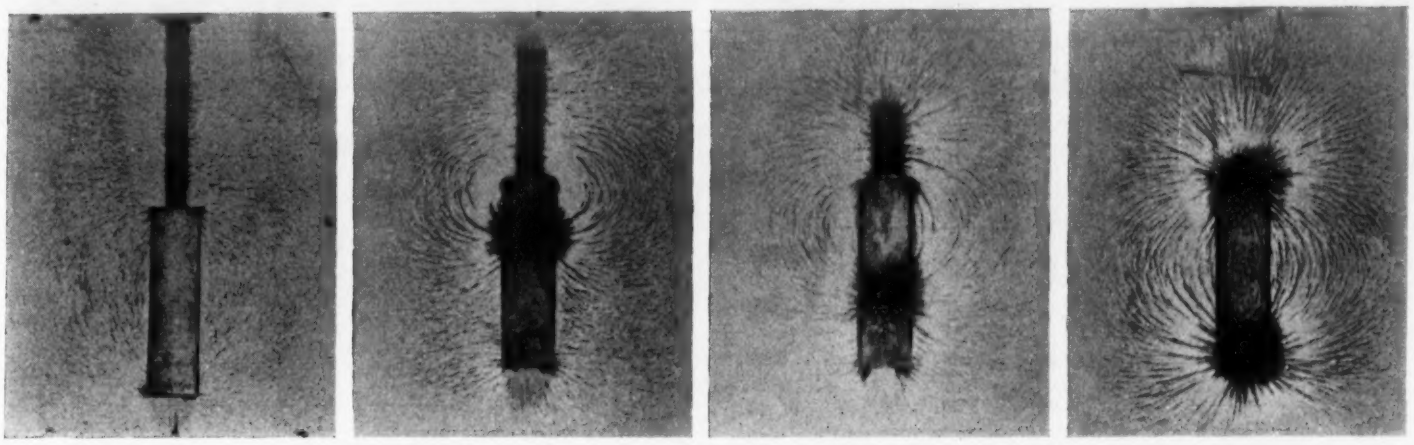


FIG. 2.—FIELD OF SOLENOID FOR DIFFERENT POSITIONS OF PLUNGER.

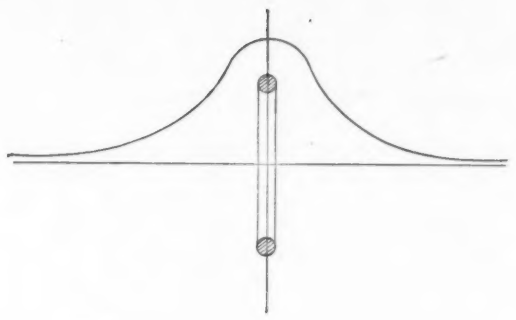


FIG. 3.—FORCE CURVE DUE TO A SINGLE CONDUCTOR CARRYING A CURRENT.

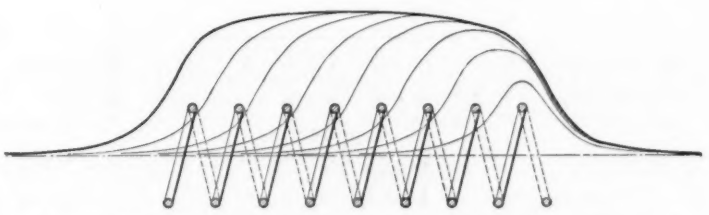


FIG. 4.—COMBINED FORCE CURVE DUE TO SEVERAL TURNS CARRYING A CURRENT.

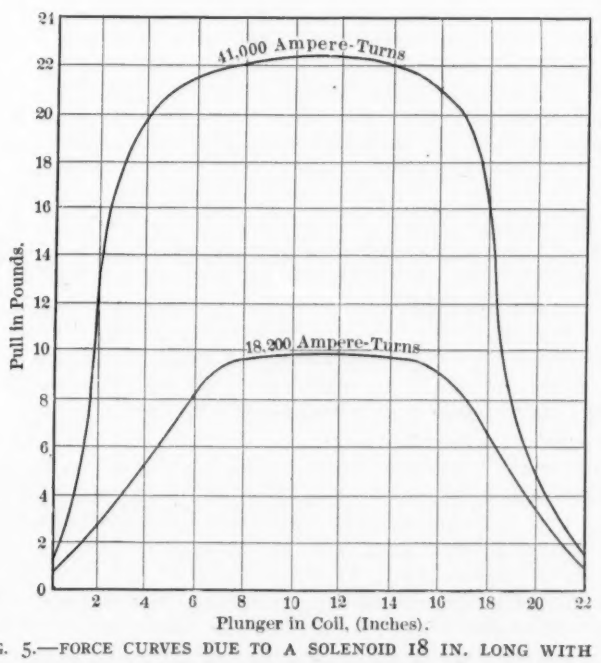



FIG. 5.—FORCE CURVES DUE TO A SOLENOID 18 IN. LONG WITH A PLUNGER 1 SQ. IN. IN CROSS-SECTION AND 36 IN. LONG.

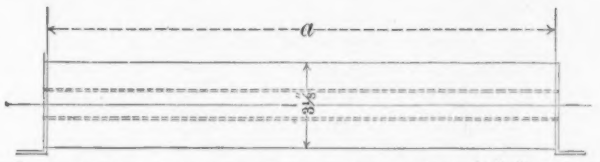



FIG. 6.—TYPE OF SOLENOID USED IN TESTS. LENGTH "A" VARIABLE.

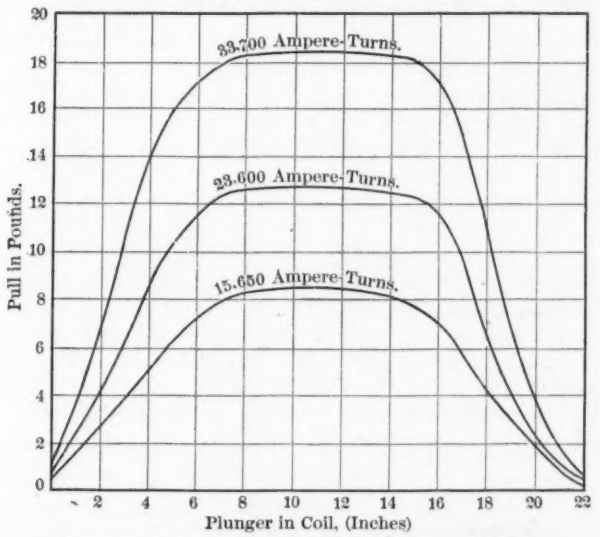



FIG. 7.—FORCE CURVES DUE TO A SOLENOID 18 IN. LONG WITH 24 IN. X 1⅛ IN. DIAMETER OF PLUNGER.

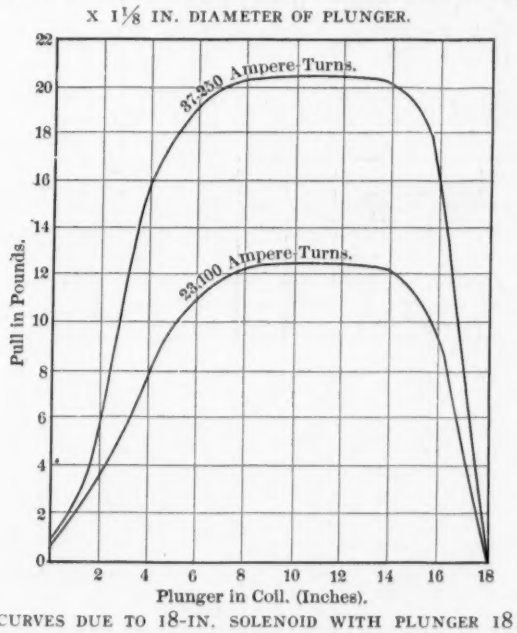



FIG. 8.—CURVES DUE TO 18-IN. SOLENOID WITH PLUNGER 18 IN. X 1⅛ IN. IN DIAMETER.

## THE PRACTICAL DESIGN OF THE SOLENOID.

plunger. The pull on the plunger also varies with the cross-section of the plunger. In Fig. 2 are shown cuts made from photographs,

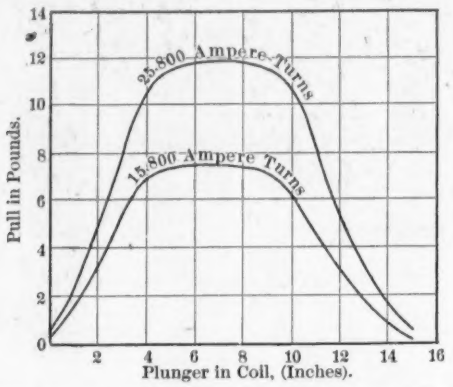



FIG. 9.—EFFECT DUE TO USING PLUNGER 12 IN. LONG WITH SOLENOID 18 IN. LONG.

which show the paths of the lines of force for different positions of the plunger.

The theoretical action of a solenoid on a single pole may be calculated and plotted in the form of a curve. Fig. 3 shows the

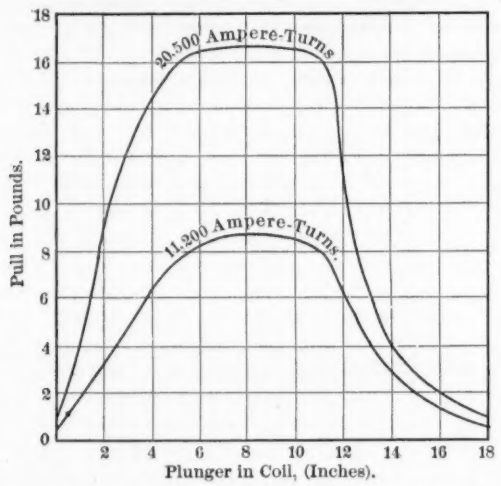



FIG. 10.—CURVES OF 12-IN. SOLENOID WITH LONG PLUNGER.

curve of attraction due to a current flowing through a circular conductor, acting upon a magnetic pole of unit strength, and Fig. 4 represents the action due to the same current flowing through several turns of wire of the same radius, acting on the unit magnetic pole.* It will be observed that after the magnetizing force has risen to its maximum, it is constant for a large proportion of the entire length of the solenoid, when it

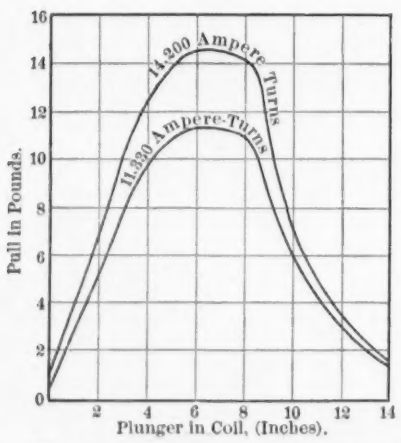



FIG. 11.—CURVES OF 9-IN. SOLENOID WITH LONG PLUNGER.

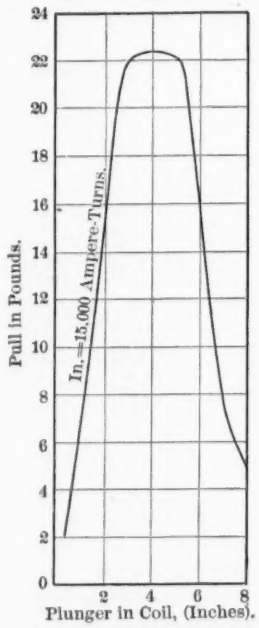



FIG. 12.—CURVE OF SOLENOID 6 IN. LONG WITH LONG PLUNGER.

again falls off quite abruptly, and then reduces gradually to zero.

In practice, where soft iron plungers are used, the results are not the same as with the theoretical pole, but the general principle is the same, so far as the attraction of the pole inside the winding is concerned.

To illustrate graphically the range and pull of solenoids, there are shown the following charts which have been plotted from actual tests made by the writer. Fig. 5 shows the results of tests made with the solenoid in Fig. 6, the length of the winding "a" being 18 inches. These tests were made with a plunger having a length twice that of the winding; that is, 36 inches, and a diameter of 1⅛ inch. It will be noticed by reference to the chart, that the total range in this case is approximately 22 inches, due to the excess length of the plunger over that of the winding.

The uniform range, that is, where the pull is practically constant, commences after the plunger has been drawn into the winding seven inches, and ceases after it has been attracted fifteen inches, thus the uniform range is 8 inches. It will also be noticed that the range is the same in both curves, and that the pull varies in direct proportion to the ampere-turns.

Fig. 7 shows three curves, taken from tests made with the 18-in. solenoid, but with a plunger 24 in. long and 1⅛ in. in diameter, and Fig. 8 shows the result of tests made with the same solenoid, using

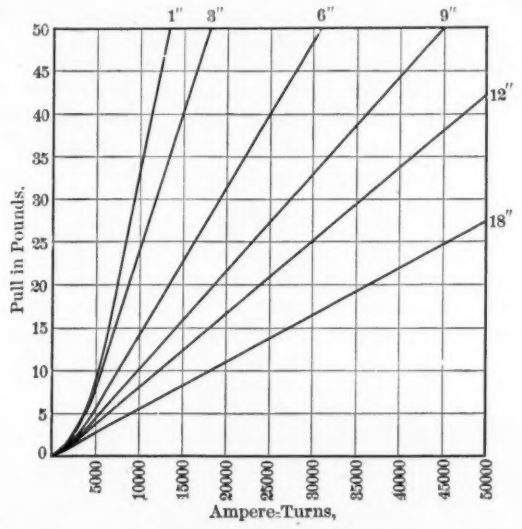



FIG. 13.—PULL DUE TO SOLENOIDS OF DIFFERENT LENGTHS WITH PLUNGER 1 SQ. IN. IN CROSS-SECTION.

a plunger 18 in. long; that is, one of the same length as the winding. Therefore, the total range can be only 18 in., but the uniform range is nearly the same as in the two previous cases, through falling off sooner. It will be noted that the attraction per ampere-turn is practically constant for all three cases. If the plunger should be withdrawn from either end of the solenoid in the test just cited, the results would be exactly the reverse of Fig. 8.

The curves in Fig. 9 show the results of a test made with the same solenoid used in previous tests, but with a plunger 12 in. long, that is, one of two-thirds the length of the winding. It is well to note here that the plungers used were all of the same diameter; that is, 1⅛ inches.

All of the coils described were of the same diameter; that is, 3⅛ in.

The curves in Fig. 10 were made with the solenoid shown in Fig. 6, the length "a" of the winding being 12 in., and with a plunger 36 in. long. Fig. 11 shows the result of tests made with a solenoid 9 in. long and the 36-in. plunger, and in Fig. 12 is shown the curve of a solenoid 6 in. long with the same plunger.

The tests just described were made with plungers of Swedish iron. In making the tests, the solenoid was attached to the scales and the scales then balanced, the plunger being rigidly fastened to the frame of the testing apparatus. The results, therefore, are independent of the weights of the plungers.

Tests not shown plotted in curves, together with those described, showed that all other conditions remaining constant, the attraction per ampere-turn varies directly with the cross-section of the plunger for equal lengths, whether in the form of a solid rod or a hollow tube. The surface area makes very little difference in a practical test.

In Fig. 13 are shown the relative attractions of solenoids of different lengths, for each square inch of cross-section of core. These curves show that the maximum attraction for very short solenoids

*S. P. Thompson's "The Electromagnet."

is much greater than for longer ones, therefore, the law of the solenoid is, to a certain extent, analogous to the law of the lever, in that what is gained in motion is lost in power, and vice versa.

In designing a solenoid, the pull should be taken at a point on the curve which is considerably below the maximum, as this will allow for enough extra attraction to overcome any friction, and also to keep the load moving, and by assuming a low point for the necessary pull, the effective range will be greatly increased.

## Electric Supply Companies and the Law of Negligence.

By W. Valentine Ball, M. A., Cantab., Barrister-at-Law.

As the law of negligence in the United States is modelled upon that which is applied by English judges, it is apprehended that American lawyers, who are interested in the law affecting the supply of electricity to the public, will be glad to take note of any English case which bears upon the subject. Such a case has recently been discussed in the High Court of Justice; a short note as to the effect of the decision, together with some comments upon the principle involved, may be of interest to American readers of Electrical World and Engineer.

A few observations upon the legal position of a company or local authority supplying electricity in England must first be made. These bodies supply electricity under what is known as a "Provisional Order" made by the Board of Trade, which is confirmed by, and has the full force and effect of, an Act of Parliament. There are also certain public acts which enunciate principles applicable to every company or municipality supplying electricity. Although in theory every municipality or company has its own provisional order, in practice the statutory obligations of these bodies are the same all over the country. Put shortly, the provisional order taken in conjunction with the general electric lighting acts, enables the "undertakers" (that is, the body authorized to give the supply) to lay mains in streets, build generating stations, and generally to do all things necessary for the purpose of enabling them to grant a supply of electricity in a given area. Inasmuch as the undertakers acquire a limited monopoly for this purpose, certain obligations are imposed upon them. Thus they must grant their supply at all times and at a uniform pressure to any consumer. The maximum prices which they may charge are prescribed by their order; and in making their charges they must show no undue preference to any consumer or class of consumers. Finally, they must pay close attention to any regulations made by the Board of Trade for the purpose of ensuring the safety of the public. These regulations provide (in effect) that the entire installation shall be approved by an official of the Board of Trade before the system is put into practical operation.

Having regard to the duties and obligations which are imposed upon the undertakers, it might be thought that, so long as they take every reasonable precaution to prevent accidents, their liabilities are limited. But no; there is a clause in nearly every provisional order to the effect that the undertakers shall be liable for negligence. This clause is in the following form:

"The undertakers shall be answerable for all accidents, damages and injuries happening through the act or default of the undertakers or of any person in their employment, by reason or in consequence of any of the undertakers works, and shall save harmless all authorities, bodies and persons by whom any street is repairable, and all other authorities, companies and bodies collectively and individually, and their officers and servants, from all damages and costs in respect of those accidents, damages and injuries." A further clause provides that "nothing in the provisional order shall exonerate the undertakers from any indictment, action or other proceedings for nuisance in the event of any nuisance being caused or permitted by them."

What, then, is negligence on the part of a company or corporation supplying electricity? According to the case which forms the text of this article, the question whether they are guilty of negligence is to be answered wholly irrespective of the fact that they are empowered by Parliament to supply electricity.

We now come to the facts of the case in question. The corporation of Manchester are empowered to supply electricity within their municipality. The action was brought by a firm of merchants in Manchester, named Midwood & Co., to recover £677:4:6, damages sustained by the plaintiffs by reason of the destruction and damage to their stock in trade at Franklin Street, Manchester, caused by a fire resulting from the fusion of one or more electric cables or service lines belonging to the defendants. The fusion was alleged to be owing to a dangerous fault or leakage in the circuit of which the cables in Fountain Street form a part. It was also contended that the defendant's system of electric lighting constituted a nuisance. The defendants pleaded that the matters conplained of were incidental to or inevitably resulted from the due discharge of their public duty under the Electric Lighting Acts, for the result of which they were not responsible, and that the short-circuiting in their mains was not due to their negligence or the negligence of any persons in their employment. The supply was given through mains worked in the five-wire system. The mains were laid in wooden troughs filled with bitumen. They were put down in 1898 in accordance with the system best known at that time, and under the advice of an eminent electrical engineer, the late Dr. John Hopkinson.

From evidence to which both parties agreed, is appears that on a night in May, 1903, it was noticed at the central station that the demand for current was continually rising. To meet the demand more machines were put on. The effect of this was to send more current through the cables. As the whole system in Manchester is linked up, the difficulty of locating a fault is very considerable, and it was alleged by the plaintiffs that this was an important factor in the charge of negligence, it being suggested that by dividing up the town in sections a fault could have been more easily located. As a matter of fact, what happened was that a short-circuit had taken place in the mains opposite the plaintiff's premises. As a result of the short circuit an enormous amount of heat was generated which vaporized the bitumen, caused a violent explosion and in the end burnt out a warehouse belonging to the plaintiffs. The station engineer, having suspected there was something amiss, arrived on the scene shortly after the explosion and averted further disaster by switching off the current. Some extracts from the evidence given by the defendants' witnesses may here be given.

In the course of his evidence, Mr. W. H. Patchell, an engineer, said: "Mains are sometimes laid in the street, that is the roadway, and sometimes under the footway. It depends whether there is space for it under the footway. The rule in London is to lay them under the footway when there is space; when there is not sufficient room under the footway we put them in the roadway." Mr. Moulton (counsel for the defendants): "Is it a natural consequence of a fault in mains so laid to burn houses? Is it a thing which would frequently occur?"—"It very, very rarely occurs. Of course it occurred, no doubt, in this case?—The danger is generally confined to the mains.

The evidence given by Mr. Swinhorne (another engineer, who gave evidence on the part of the defendants) in cross examination is of great interest.

Mr. Bousfield (counsel for the plaintiff): I suppose you agree that the feeder ammeters at the central station give very valuable indications as to the locality of a serious fault? A. Yes; they give indications which are valuable because they are the only indications which you can get. They are not clear indications, but being the only indications they are valuable.

Q. I suppose you agree that those indications would be far more valuable in Liverpool divided up into 100 separate circuits than in Manchester which has one big network?—Not necessarily, because if you have a large network at the end of a single feeder you may locate the fault in the large network, but further you have no information on the single feeder system. But if you have a lot of feeders as you have in Manchester and a big fault occurs in the evening, say when the load is heavy, then the fact of having a lot of feeders will give you a better indication than a single feeder will.

The question whether the central station engineer (Mr. Howard) was right in putting on more machines for the purpose of locating the fault was also much canvassed. In particular Mr. Swinhorne was cross examined upon this part of the case as follows:

Now as regards what Mr. Howard did, you know that a material part of what was done was to put on extra machines at Manchester?—Yes.

You approve of the system, do you?—Yes, it is the right thing to do unless one knows there is absolutely something wrong.

It is the system of burning out a fault?—Well, you do not know there is a fault. Of course we are all talking with the subsequent knowledge that there is a fault. If you take the minds of the people in the station they do not know there is a fault. It is their busi-

ness to keep the pressure right and to send up and see what they can.

You do not suggest that they did not know at this time that there was a bad fault?—They knew there was something wrong. I think they knew by 1.45 that there was a bad fault on.

You say that Mr. Howard did right in beginning to localize it and so on. Of course everybody knew perfectly well that long before they had got the localizing business done there would be smoke or fire somewhere, did they not, with a fault of that magnitude? Yes.

And really in Manchester what they rely on to get at a fault is not by the splitting up of a district, but the report they get from the policeman as to where the smoke is coming from? Yes, if the fault is big enough.

In giving evidence in chief this witness said that he did not know any better system of localization that the one which Howard carried out. Counsel for the defendants argued that so long as the corporation took the best advice, and worked their system in accordance with the Board of Trade regulations, they ought not to be held liable. The jury found however, (a) that the system adopted by the defendants constituted a nuisance by causing danger to persons having premises adjacent to the mains; (b) that they were guilty of negligence in the adoption of the method of localizing and dealing with faults; and (c) that when they became aware of the fault they did not deal with it for the purpose of preventing fire in a reasonable and proper manner. Upon these findings the judge entered judgment for the plaintiff for the amount of damages which had been agreed.

The result of this case is that an electric supply company has been found guilty of negligence although to all appearances they did nothing more than they were compelled to do by statute. Further, they complied with all the requirements and regulations as laid down by the Board of Trade.

The engineer at the central station knew that he was bound to keep up a constant pressure, and he further knew that failure to supply electricity in accordance with the terms of the provisional order might render the corporation liable to penalties. Thus, it is provided by an act which applies to nearly every electrical undertaker that whenever default is made in supplying energy to the owner or occupier of premises to whom they may be, and are required to supply energy under the special order, they shall be liable in respect of each default to a penalty not exceeding forty shillings for each day on which the default occurs.

When it is contended that the default is due to the insolvency of the undertakers, the Board of Trade may, after due inquiry, revoke the special order. Penalties inflicted upon undertakers under this section must in no case exceed, in the aggregate, in respect of any defaults not being wilful defaults on the part of the undertakers, the sum of £50 for any one day. No penalty, however, is to be inflicted if the court is of the opinion that the default was caused by *force majeure*, or was of so slight or unimportant a character as not materially to affect the value of the supply. The penalties above mentioned may be recovered not only where there is a neglect or refusal to supply gas under such pressure as is prescribed, but also where there is a neglect or refusal to supply energy at all; consequently the section applies in cases where the company have improperly cut off the supply.

The meaning of the phrase, "*force majeure*," or "inevitable accident," was discussed in a case which was heard in Dublin in the year 1899 (e. g., Sun Insurance Company vs. Dublin Corporation, *The Electrician*, Dec. 9, 1899). It was there held that where a cable laid down proved defective, and the supply of energy thus broke down, the plea of inevitable accident would be successfully urged in answer to a claim for penalties. But assuming that, in the Manchester case which has formed the theme of this article, the consumers affected by the breakdown were to bring suit against the corporation for penalties, could the corporation, after the findings of the jury to the effect that they had commited a nuisance, and have been guilty of negligence in their method of identifying a breakdown, say that the stoppage of supply was due to *force majeure* or inevitable accident? As we stated at the commencement of this article, the decision in this case is likely to be of considerable importance, in view of the fact that the legal position of all undertakers in England is practically the same as that of the Manchester Corporation.

At the same time it can hardly fail to be of interest to American lawyers, inasmuch as it affords an indication of what conduct on the part of a company supplying electricity will be regarded by the court as being negligent.

## Line Effects Due to a Moving Load.

By Carl P. Nachod.

THE following calculations are interesting as a theoretical consideration of the line losses and distribution of potential due to a moving load on a trolley line fed at both extremities. They are preliminary studies for a large alternating-current freight locomotive having an input of 450 amperes at 3,300 volts. The following data are assumed:

Length of line, 25,200 ft.

Overhead conductor, No. 000 trolley wire, in parallel with 7/16-in. steel messenger cable.

| | |
|---|---|
| Circular mils of trolley ..... | 168,100 |
| Equivalent c. m. messenger cable..... | 18,900 |
| Total, outgoing conductor ..... | 187,000 cir. mils. |

Return conductor, two 80-lb. rails; area of each, 8 sq. in.

Equivalent copper, assuming roughly a ratio of conductivity of 1 to 9, between iron and copper.

$$\frac{1000^2}{.7854} \times 16 \times \frac{1}{9} = 2{,}300{,}000 \text{ circ. mils.}$$

Resistance of copper per mil foot, 10.4 ohms.

$$\text{Resistance of trolley per 1,000 ft.} = \frac{10.4 \times 1{,}000}{187{,}000} = .0556 \text{ ohm.}$$

$$\text{Resistance of track per 1,000 ft.} = \frac{10.4 \times 1{,}000}{2{,}300{,}000} = .00452 \text{ ohm.}$$

Resistance of circuit per 1,000 ft. = .0556 + .00452 = .0601 ohm.

The results of measurements at 3,000 alternations on a trial circuit gave a ratio of impedance to resistance of 1.83 to 1. Hence, the impedance or resistance of the line to alternating currents, per 1,000 ft. = 1.83 × .0601 = .111 ohm.

The power house will feed one end of the line directly, the other end being fed from a substation supplied from the power house over a high voltage transmission line. The potential is assumed constant at both feeding points.

Fig. 1 shows a series of curves having distance ($X$) of the locomotive from the power house as abscissæ, and resistance, current, volts drop, and power lost in the line as ordinates; all with respect to that part of the circuit between the power house and the locomotive.

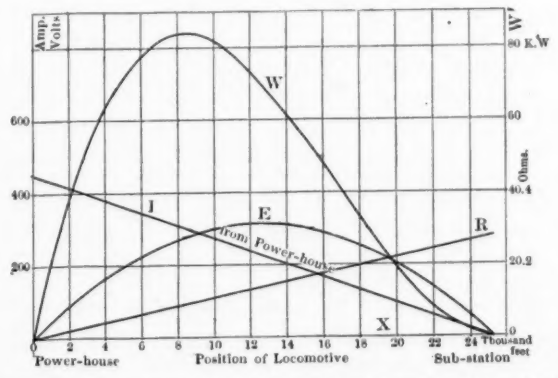



FIG. 1.—CURVES OF CIRCUIT BETWEEN POWER HOUSE AND LOCOMOTIVE.

The current curve, $I$, will be a straight line, having a value of $I =$ 450 amperes at the power house, and decreasing to zero at the sub-station. This curve is represented by the equation:

$$I = \frac{I_1 (l - x)}{l} = 17.85 \ (25.2 - x)$$

The resistance curve $R$ will be a straight line increasing from zero at the power house to .111 × 25.2 = 2.8 ohms at the sub-station. Its equation is

$$R = kx = .111 \ x$$

The line drop is the product of resistance and current. The ordinates of curve $E$ are the product of those of curves $I$ and $R$. It is a parabola whose equation is

$$E = IR = \frac{I_1 (l-x)\, kx}{l} = 198\ x\ (25.2 - x)$$

It is evident that $E$ is a maximum at $x = \frac{1}{2}\ l = 12.6$ thousand feet, at which point

$$E_1 = \frac{I_1\, kl}{4} = 314 \text{ volts}$$

$$\frac{314}{3300} = 9.5 \text{ per cent. drop.}$$

Since the area of the parabola is $\frac{2}{3}\ E_1\ l$ the average drop is

$$\frac{2}{3}\ E_1\ l \div l = \frac{2}{3}\ E_1 = \frac{I_1\, kl}{6} = 210 \text{ volts.}$$

Denoting the loss in the line between the power house and the locomotive by $W$, the loss in kilowatts is

$$W = \frac{I^2 R}{1000} = \frac{I_1^2 (l-x)^2}{l^2} \cdot \frac{kx}{1000} = .03535\ x\ (25.2 - x)^2,$$

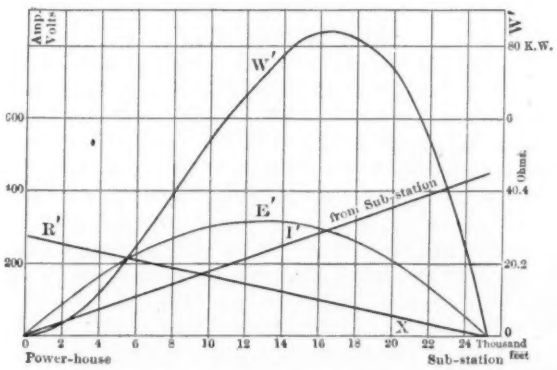



FIG. 2.—CURVES OF CIRCUIT BETWEEN SUB-STATION AND LOCOMOTIVE.

which is plotted as curve $W$. It has a maximum at $x = \frac{1}{3}\ l = 8.4$ thousand feet, at which point

$$W_1 = \frac{1}{1000} \cdot \frac{4\, I_1^2\, kl}{27} = 84 \text{ kw.}$$

In Fig. 2 is plotted a second series of curves similar to the first, but relating to the circuit between the locomotive and the sub-station. It will be noticed that curve $E^1$ is the same as $E$. $W^1$ will

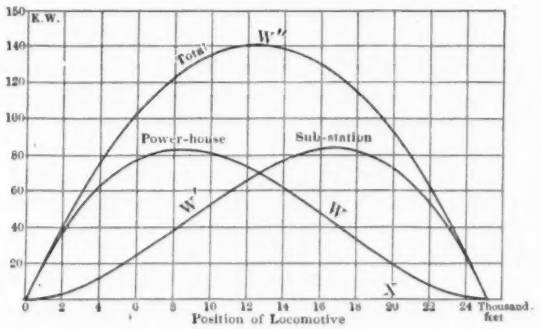



FIG. 3.—CURVES OF LINE LOSSES.

be found to have the same maximum as $W$, but it occurs at $x = \frac{2}{3} - l$, or at 16.8 thousand feet from the power house.

The total current taken by the locomotive is the sum of the curves $I$ and $I_1$, equal to 450 amperes at all points.

The total line loss $W''$ supplied by both stations is the sum of the curves $W$ and $W'$, or of their respective equations. Fig. 3 shows this addition, while the equations give

$$W'' = \frac{I_1^2\, kx}{1000}\left(1 - \frac{x}{l}\right) = 22.48\ x\left(1 - \frac{x}{25.2}\right)$$

This is a parabola having a maximum at $x = \frac{1}{2}\ l = 12.6$ thousand feet; at which point

$$W_1'' = \frac{I_1^2\, kl}{4000} = 141.5 \text{ kw.}$$

This particular value could have been obtained more directly by determining twice the loss due to one-half of the load current flowing over one-half of the total circuit.

## Convention of the Iowa Electrical Association.

THE Iowa Electrical Association held its fifth annual convention at Dubuque, Iowa, April 19 and 20, 1905, at the Hotel Julien. President W. L. Bowers, of Davenport, called the first session to order at 10.30 a. m. and introduced Mayor C. H. Berg, of Dubuque. In welcoming the convention to the city of Dubuque, Mayor Berg said he had never before in his life faced so much electricity, and that he was shocked to see such an audience (laughter). His remarks should have some electricity in them, but that was impossible. His hearers had the monopoly on that. He was glad to welcome such a representative set of men to Dubuque.

Mayor Berg's welcome was responded to by Secretary W. S. Porter.

President W. L. Bowers then gave the president's address. He asked the co-operation and assistance of all who attended the convention to make it a success, and urged a strong, healthy discussion of the papers. A year ago steam turbines had been discussed on the floor of the convention as a future possibility in Iowa central stations. This convention would have opportunity to visit a steam turbine plant in full operation, built in Dubuque within the past year. He briefly referred to the prevalent attempts at municipal control and regulation of electric lighting companies, most of which fail of the real purpose for which they are intended and act mainly as irritants.

Secretary W. S. Porter presented his fifth annual report, which he said would be his last. He called attention to several matters which he thought should receive more consideration by the association. The standing committee of the association on "Facts and Factors," he thought, had been poorly understood, or the members would make more use of it. This committee should be a kind of clearing house for all operating troubles, to which members could send for information and receive in return advice as to various problems on which they want light. As the majority of the small stations in Iowa still cling to the flat rate system of charging, he thought a paper on the advantages of meters should be presented at next meeting. He believed that were attention given to the matter, important saving in insurance rates could be made by members. The financial policy of the association should be changed. The membership of the association is now about as large a per cent of the central station companies of the State as could be expected. The income will soon be proving insufficient to carry on the affairs of the association as before, unless some changes are made. Either the dues must be increased, the membership must be extended to supply men and others or the association must discontinue printing its proceedings in full.

A nominating committee was then elected by ballot, consisting of D. F. McGee, of Red Oak; W. J. Greene, of Cedar Rapids; A. W. Zahm, of Mason City; Austin Burt, of Waterloo, and J. A. Innes, of Eagle Grove.

Mr. W. J. Greene, of Cedar Rapids, offered an amendment to the by-laws increasing the annual dues for companies operating in cities of over 5,000 inhabitants. The amendment was later adopted in executive session, Thursday. The new rule makes the annual dues $5, as before, for all companies operating in towns of less than 5,000 population. Those in towns of 5,000 to 10,000 are to pay $15, and for those in towns of over 10,000 the dues will be $25.

"Methods of Obtaining New Business" was the title of a paper read by Mr. L. D. Mathes, of Dubuque. He first called attention

to the fact that this is an advertising age, and that electric lighting business is as susceptible to advertising treatment as any other. The central station company in Boston spends $35,000 in advertising annually, and finds that it pays well, while large amounts are also spent in New York, Chicago and other large cities. Whatever advertising is done must be done systematically, preferably using a card index system giving a list of the present and possible customers to whom advertising matter of different kinds should be sent, showing what printed matter had been sent to each, and what personal solicitation had been made. It is well not to have too much system, however, as it may take a solicitor more time to keep his records in such a case than he can spend soliciting business. Mailing lists should be kept free from dead wood, as it costs too much for printing and postage to send printed matter continually to impossible customers. He spoke of the regular monthly papers published by the Chicago and New York Edison companies. The Chicago Edison Company had made good use of large electric signboards for advertising. It was possible for the smaller plants to circulate their advertising matter more intelligently than the large because they would know better just what people would be possible customers. In small towns people are more likely to read circulars than in cities. The small plants should, therefore, get more returns for a given amount of money sent in advertising than the ones operating in the great cities. First get the interest of the person solicited and then follow up with circulars of various current-consuming devices. Most people have little idea of what the market affords in the way of electric cooking and heating devices. They have read somewhere about a 10-course dinner being served some years ago cooked by electricity, but have an idea it is an interesting scientific experiment rather than a practical, every-day possibility. He would give demonstrations of electric cooking and heating devices, and would send out any heating or cooking device on approval with the understanding that it could be returned any time within 30 days if not satisfactory. He knew of a case where 100 electric flatirons had recently been sent out in this way, and not one had come back. There is more promise in increasing business by electric heating devices than in any other direction. At the company's office a window full of attractive lamps and other electrical devices was an excellent thing. Some maintained that a central station company could almost afford to sell portables at cost to secure the increased business that would result from them in one way and another. A Chicago publisher gets out an electric magazine on the same order as the *Electric City*, published by the Chicago Edison Company, and this magazine could be secured by the smaller companies and circulated among their customers. This magazine contains matter calculated to arouse the interest of non-technical readers in electric light, heat and power service. He referred to Grangers' method of working up business, which had been notably successful, viz., personal solicitation followed up by circulars. One very telling piece of printed matter given to possible power customers was a diagram showing the parts of an electric motor, and beside it one showing the parts of a gas engine. The furnishing of electric signs at a flat rate (the hours of burning being under the control of the company by means of a locked switch) was a good source of revenue. In all solicitation of business the dignity of the company must be preserved and solicitors must not be too aggressive.

A. W. Zahm, of Mason City, in discussion, told of experience at St. Paul, where an active campaign had been made for the sign business. A rate had been made of 25 cents per month for each 4-cp. sign lamp burning from 6.05 p. m. until midnight under control of the company. Over 400 electric signs had been placed. Many belonged to foreign corporations. Many monogram signs were taken at a fixed rate per year. About 43 foreign corporations had signs. The large signs were placed on high buildings and on billboards on vacant land in outlying districts, where they could be seen a long distance along interurban lines.

Austin Burt, of Waterloo, thought it most important in soliciting both motor and lighting business to be able to convince customers of the company's equipment being such that it could give absolutely reliable service. Before a manufacturer would make the operation of his factory entirely dependent on electric power he would want to be sure he could depend on the service. If the central station was full of old machinery that was liable to break down frequently, better throw it out and get something that can be depended upon.

P. E. Bellamy, of Knoxville, cited an instance where all evidence used to persuade a flour mill owner that electric power was more economical failed to get the business until finally it was suggested to the mill man that the fact that his mill was electrically operated could be used by him as an advertising and talking point in selling his flour. Then he made his change.

Mr. Mathes, in connection with solicitation of power business from owners of steam plants, said that if the central station man wasn't sure of his ground, and unless he knew that he could offer a customer a better proposition than steam, he had better not make a proposition. He should investigate thoroughly the conditions in the steam plant, indicate the engine, find out how much coal was burned and learn in advance just what might be expected.

D. F. McGee, of Red Oak, told of a desirable class of business he had secured, viz., mechanical refrigeration plants at meat markets, etc. This business was given a low rate because it could be shut off during the peak load at the company's will. The brine storage capacity of the refrigerating plant made this possible.

Austin Burt, of Waterloo, said some had been worrying about the effects of the private gasoline plant on the electric light business. He advised them not to worry, as these machines depreciate rapidly, and the owner will usually be back to electric lighting service in a few years. A $70 gasoline plant would last about three years. Furthermore, gasoline is sure to advance in price.

This closed the Wednesday morning session.

Wednesday afternoon the first paper was a report on "Commercial Lighting" by J. A. Innes, of Eagle Grove. In this the attention of members was called to the increase in efficiency and improvement in color and steadiness of arc lamps by reducing the size of carbons from one-half to five-sixteenths inch on the 3.5 and 5-ampere arc lamps. The results secured by Mr. George N. Eastman given in his A. I. E. E. Chicago paper (See ELECTRICAL WORLD AND ENGINEER of April 8 and April 15, 1905) were reviewed, and the members urged to give consideration to this matter. He considered the frequency of trimming necessary with the smaller carbons to be no objection, because of the loss of light by dirty globes where the lamps are run a long time between trimming as in the case of lamps with large carbons. Arc lamps of small current capacity and with small carbons were very promising as aids in commercial lighting. He also spoke of the new tantalum incandescent lamp as a possible important improvement soon to be available.

Mr. J. R. Cravath, being called upon, then exhibited several samples of tantalum lamps that he had secured at the request of officers of the association for exhibition at the convention. He cited recent tests which showed that the horizontal candle-power of the tantalum lamp is about double, for a given current consumption, that of a carbon filament lamp. However, the mean spherical candle-power of a tantalum lamp as now constructed is smaller in proportion to the horizontal candle-power than on the carbon filament lamp as usually made. The watts per mean spherical candle-power should be the basis of comparison of illuminants. Any other basis would be misleading. The watts per mean spherical candle-power taken by the frosted bulb tantalum lamps in tests by Dr. A. E. Kennelly and S. E. Whiting were about 3, and the watts per mean spherical candle-power of the frosted carbon filament lamp were probably about 5, making the ratio of current consumption for the two lamps about as 3 to 5. There was no doubt as to the superior efficiency of the tantalum lamp. The question now to be determined is how long the average tantalum lamps will last. According to statements of the German manufacturers the life compares favorably with carbon filament lamps. Siemens-Halske are now turning out about 5,000 lamps per day in Germany. In response to a question he said he had no authoritative information on the price at which these lamps were selling in Germany, but learned in a roundabout way that they sell there for $1.

Mr. George S. Carson, of Iowa City, said it looked as if the tantalum lamp was going to be as much of a boon to the incandescent lighting business as the Welsbach mantle burner had been to the gas business.

A tantalum lamp which had been burned 216 hours was then exhibited by the gentleman from Cedar Rapids. This lamp had been burned long enough so that the filament had assumed a rough appearance in distinction to the smooth, bright surface of the new filament.

Mr. W. J. Greene, of Cedar Rapids, told of great success in the use of Nernst lamps in commercial lighting. A year ago they had 500 on his circuits, and now there are 1,000. The company maintains the lamps, and finds that the cost of maintenance and renewals

of glowers is one-half cent per kw.-hour.

Mr. C. F. Freehauf, of Cresco, also reported a large number of Nernst lamps in use with excellent results.

A report was then read by Mr. P. E. Bellamy, of Knoxville, on "Commercial Power." He said that in making this report he had labored under the difficulty that few central stations in the State analyzed the results of operation so as to be able to tell just what they were doing in the way of power service and what the earnings and investment in power might be as separated from lighting service. Most of the large plants reported in favor of polyphase motors for power service. The class of business generally considered most desirable was small motors operating a large number of hours per day. None thought it best to make a flat rate on motors.

Mr. Austin Burt considered that nearly every station could take on a certain amount of power load without adding a cent to its investment.' Such power load, of course, must be such that it does not cover the period of peak load. Power of this kind could, therefore, be taken very cheaply.

Mr. George S. Carson, of Iowa City, asked how a company could get a power load that would not be on during the peak load. The company must be able to furnish power whenever the customer wanted it, and had no control over the times that it would be used.

A discussion on rates followed, in which it was the sentiment of a large number of speakers that there must be no discrimination between different customers as to rates; that general rules as to rates must be laid down and no customer given a better rate than another unless he has earned it and is entitled to it under the regulations which apply to all. The question was asked as to the possibility of limiting the hours of power service.

Mr. L. D. Mathes said this was largely a dream. After attempts to do this in Dubuque, the company now makes the same rate to all customers. Any discrimination is sure to be a boomerang that will come back and hit the company some day.

Mr. L. Sparrow, of St. Louis, read a short paper on the Wagner single-phase elevator and hoisting motor. This motor, which has recently been put on the market, behaves as regards current consumption almost exactly like a shunt direct-current motor, giving a torque in starting in direct proportion to the current used. In elevator service the excess torque and current over the normal in starting is not less than 50 per cent. This excess current, however, falls rapidly as the elevator is accelerated. The polyphase induction elevator motor may require as high as 500 per cent. more than full load current in starting. This motor makes it possible to give with a single-phase distribution all the kinds of service given by direct current at the present time, and more than are usually feasible with polyphase motors. The new Wagner motor has a power factor of at least 70 per cent in starting and 80 to 85 per cent when running at full speed. The motor in elevator service can be used as an electric brake running as an induction generator, the armature rotating at a speed in excess of synchronism. The motor is capable of 40 per cent speed variation, with constant speed at whatever point it may be adjusted, thus making it applicable to ventilating fans and machine shop tool service.

"Boiler Room Economies" was the subject of a paper by Mr. F. H. Lankashier, of Davenport. He classified the different kinds of boilers and showed the conditions to which each class was especially suited. If the water used was dirty and full of scale-forming solutions, it was best to select a boiler with straight tubes which could be easily cleaned. If the water is clean and almost free from scale, one could use a cheaper construction of boiler having crooked tubes. In boilers in a power plant having a variable load, a large steam storage capacity is desirable, but this is not the case in power plants having a constant load, as the additional storage capacity simply adds to the losses by radiation and to the first cost of the boilers.

Boilers of the water-tube type were usually considered as less dangerous than those of the shell type; nevertheless, accidents do frequently occur with water-tube boilers, although accidents with these boilers did not usually cause the wholesale destruction worked by explosions of shell-type boilers. With water-tube boilers, the tubes over the fire will probably blow open the fire doors, and burn and scald the firemen if they are near. These accidents while serious in the boiler room are not known of outside. Curved-tube boilers are good for clean water and steady loads. The circulation in some of these boilers is so remarkably strong as to have a scouring effect on the tubes. One good thing about the upright type of boilers he considered was the fact that this type usually requires a Dutch oven furnace, which is in itself a good thing. We are too apt to talk of the efficiency of a boiler when it is really the efficiency of the furnace that we mean. The efficiency of the boiler depends mainly on the efficiency of the furnace. About 50 per cent of the boilers in use are set too near the grate bars, thus cooling the hot gases before there is a chance for thorough combustion. Good combustion can never be secured when the gases are cooled in this way. He then took up the different types of furnaces and stokers The down-draft furnace secures a perfect combustion, but the water grates above the fire leak and give trouble. Gravity feed stokers fail to take care of clinkers in Western coal. Underfeed stokers require forced draft, which is objectionable, and also must be divided into a number of rather small units, which is also objectionable. The character of the furnace is such that ashes must be removed by hand, and this adds to the labor necessary. He considered the chain grate the most satisfactory. In answer to questions asked after the reading of this paper, he said he did not consider mechanical stokers of any kind desirable in a plant as small as 400 hp, because such a plant would have to be divided into small boiler units, and the cost of grates for each unit would be prohibitive.

Mr. C. F. Freehauf, of Cresco, said that he had a small plant in which gravity feed stokers were used. He obtained an evaporation of 7.5 pounds of water to a pound of coal with loads varying from one-quarter to full load. In his case it was a good investment, as he had a plant which could be operated by one man on each shift, whereas if he did not have the automatic stokers another man would be required on each shift.

Mr. Austin Burt told of excellent results he had secured with a combination water-tube and shell boiler, known as the Iowa boiler, made at Dubuque.

A. W. Zahm, of Mason City, presented a paper on "Methods of Accounting," which was a description of the bookkeeping system used by his company, and as it referred mainly to forms submitted, does not permit of an abstract here.

Mr. F. E. Foster, of Iowa Falls, thought a uniform system of accounting among the smaller stations very desirable, so that they could compare results.

A discussion followed as to the best method of making collections. Some of the larger stations give a discount for prompt payment, but it seems to be the general opinion that in the smaller towns, if the manager or bookkeeper would take the bills around personally, promptly at the first of the month, nearly all of them would pay, avoiding any necessity of discounting for prompt payment and also avoiding hard feeling, which is likely to arise in a small town if the discount is not given to a delinquent.

A member asked a question as to whether it was advisable to include the meter readings on a bill.

Mr. McGee thought it was very desirable, as it enabled a customer to check the bill himself. Furthermore, he made it a point whenever he connected a new customer, to teach the customer something about reading the meter, and by so teaching a customer to check his own bills, he thought that most complaints would be avoided. He would also teach a customer how to make rough tests on the accuracy of his meter by turning on a certain number of lamps for a certain time. This also was conducive to freedom from complaints as to fast meters.

Mr. Burt had found that prepayment meters were useful for certain classes of customers. Some such customers, for example, as railroad men in a division town, who might move away frequently, but usually had plenty of money, and used considerable light. The prepayment meters saved all trouble from collections and the rate was not objected to.

Mr. A. W. Reavy, of Davenport, reported the extensive use of prepayment meters among customers who rarely had enough money at one time to pay a monthly bill, but who were nevertheless extravagant users of light and do not object to paying the maximum rate for all the current used.

Mr. Carson called attention to the fact that manufacturers are now publishing books on how to read meters, and he thought it desirable that such books be placed in the hands of a central station's customers.

This closed the Wednesday afternoon session.

Wednesday evening the Union Electric Company, of Dubuque, entertained the convention at the Dubuque Club. A vaudeville entertainment was provided, followed by refreshments.

Thursday morning the delegates were taken to visit the new power

plant of the Union Electric Company, erected within the past year. This plant contains Curtis steam turbines driving 60-cycle, 2,300-volt alternators. All the lighting of Dubuque is on alternating-current circuits. The railway is supplied through 60-cycle rotary converters.

Thursday morning the session was opened by the reading of a short paper by Prof. L. B. Spinney, of Iowa State College, Ames, Iowa, on the lamp-testing work of that institution, which has for a number of years made a practice of testing at cost incandescent lamps sent to it by central stations of the State. Tests of mean horizontal candle-power and watt consumption are made at the rate of $1 per dozen. Recently the Department of Electrical Engineering has added to its equipment a Matthews integrating photometer, which will enable it to make tests of mean spherical candle-power quickly and cheaply. He explained the principle of the Matthews photometer, which records simultaneously the candle-power from eleven different angles and integrates the results so that a reading is obtained directly of the mean spherical candle-power. Incidentally, he called attention to how illogical is our present method of rating lamps by horizontal candle-power. This rating has been adopted mainly because of the difficulties involved in the past in making a test for mean spherical candle-power. However, the only true measure of the efficiency of any lamp is in watts per mean spherical candle-power, and it is probable that in the near future this, rather than horizontal candle-power, will be the basis of rating of all illuminants. Tests are to be made at Ames to show the difference between ratio of horizontal candle-power and spherical candle-power with different kinds of filaments. He said that the work at Ames was conducted for the benefit of the people, and he would be glad to have suggestions from those for whom the work is being carried on as to what they need.

The president then introduced F. L. Perry, of Chicago, assistant master of transportation of the National Electric Light Association, who spoke a few minutes on the coming Denver and Colorado Springs convention of that association, and urged Iowa central station men to attend. Announcements as to special trains would be sent out later.

Mr. E. B. Hillman, of Quincy, Illinois, president of the Illinois State Electric Association, being introduced by the president, told of the fight for existence which electric lighting companies in Illinois are just now going through. Bills had been introduced in the Illinois Legislature putting the regulation of rates of electric light companies entirely in the hands of city councils or local boards, thus making it possible for a city council at will to ruin the business of any electric lighting company in the State. The electric lighting interests of the State had been gradually waking up to how serious the situation was and seventy-five plants were represented in Springfield yesterday. There was undoubtedly a strong sentiment all over the country in favor of some kind of regulation of corporations. The electric lighting interests of the State, recognizing this sentiment, and being willing to have any fair kind of regulation adopted, intend to prepare a bill for the regulation of public service corporations of Illinois on the order of the Massachusetts laws. In Massachusetts these matters are under the control of the commission. Competition in public service is not possible in any town in Massachusetts unless evidence can be brought before the commission that the company already in the field is not serving the public properly. This plan safeguards the investor and the public.

Mr. D. F. McGee, of Red Oak, presented a short report on "Hot Water Heating." Mr. McGee said that he had been unable to obtain data of any value on this subject from the central stations of the State, either because the companies could not give the information desired or did not wish to. He, therefore, was obliged to fall back mainly on his own experience in making this report. The principal point he brought out was that it is possible to get the power business of some customers if heating service can be supplied also. If such customers must put in boilers and heat their buildings, they will also add a steam engine for power and possibly for lighting. This constitutes one of the chief advantages to a central station in going into the heating business.

Mr. Burt asked Mr. McGee what price per square foot of radiating surface he would charge per season if he were establishing a heating plant independent of anything else in Red Oak. Mr. McGee thought he would charge not less than 25 cents per square foot. In answer to another question he said he would never take on a customer unless that customer would put in enough square feet of radiation to keep his rooms at a temperature of 70° in the coldest weather. The customer might say he did not care for that much heat, but this customer might move away and the next one would want more, or the first customer might want more than he thought. He would insist on starting with plenty of radiating surface, taking back some if necessary in order to be sure that each customer was receiving plenty of heat. He figured on delivering water at the customer's basement at a temperature of 180° in the coldest weather. This might be lowered almost to atmospheric temperature in warm weather.

Mr. W. J. Greene, of Cedar Rapids, who operates a steam heating plant, said that all the buildings he connected to were piped with the understanding that the company agrees to furnish steam at one pound pressure at the building.

Mr. McGee said that he had found it difficult to keep customers away from his heating service even though he had raised the rates, in the hope that it would drive some away, as he had about all he could economically take care of with his present power load.

Mr. A. W. Zahm said he had the same experience at Mason City, where they had raised the price three times in the hope that it would stop the increased demand for heating, but customers still kept coming.

Mr. Carson asked whether it would not be better on starting in to put in the best type of compound condensing engines, and get the economy to be obtained by condensing and compounding, rather than to sell the exhaust steam and put in a simple non-condensing plant.

Mr. McGee replied that his company could not afford to operate without heating, as it was by means of heating that it had been able to secure a power load, as he had said before. He expected to put in a new unit soon, which four months of the year will be run as a compound condensing unit. For about two months of the year a part of the heat of the exhaust will be utilized in hot water heating. The balance of the year or six months, all the exhaust steam heat will be used in the hot water heating system.

Mr. W. S. Porter, of Eldora, warned all companies against the mistake of extending their heating mains into the residential district. Keep the heating mains confined to the congested business area of a town, where customers are thick, and one will soon have all the heating that can be taken care of by the station.

Mr. Walsh favored charges according to cubical contents of buildings heated rather than by square feet of radiation. He asked what advantage there was in meters in selling heat.

Mr. W. J. Greene, of Cedar Rapids, replied that with meters a company knew what a man was using, otherwise it had no knowledge. A customer might have a leaky building or keep his windows wide open and the company have no recourse unless meters were used, in which case the customer paid for just what steam he used. The meters for measuring the water of condensation in a steam heating system were reasonably accurate.

Thursday afternoon a meeting was held in conjunction with the Iowa Street & Interurban Railway Association, which held its convention at Dubuque that day and the day following. The paper considered in the joint session was one by Mr. W. E. Boilleau, engineer of the Union Electric Company, Dubuque, on "Steam Turbines." This paper was a rather comprehensive review of the steam turbine situation up to date, much of the information having been given in previous papers before technical societies. He described briefly the three principal types of turbines that have been used, namely, the De Laval, the Parsons and the Curtis. He then went into a detailed description of the Curtis turbine. He called attention to the possibilities of using low-pressure steam turbines with high-vacuum condensers, to increase the efficiency of power plants equipped with non-condensing engines. One useful practical suggestion given was that the vacuum secured in a condensing system might often be improved by thoroughly painting the joints, the paint being drawn into the minute leaks, the result being a much better vacuum. This was found out by practical experience.

Mr. Burt asked whether considerable trouble was not experienced with the step-bearing which takes the weight of the revolving part of the turbo-generator.

Mr. Boileau replied that the step-bearing had given as little trouble as anything about the turbine. He cited a case where through a mistake by some workman the oil supplied for lubricating a step-bearing was shut off for ten or fifteen minutes. The bearing began to smoke. When examined it was found that the surfaces were not injured in any way and that operation might have been continued

without taking the bearing apart. The bearing was put together again, oil pumped in, and there was no trouble with that bearing after that.

In the meantime a great crowd had assembled to hear a paper entitled, "Gold Brick Finance," by Mr. John G. Boyd, of Sioux City. Mr. Boyd's paper was on municipal ownership, and cited numerous failures of municipal electric light plants, bringing out the methods of figuring by which the city authorities responsible for the operation of these plants made a showing of profit where a deficit really existed. Without questioning the honesty and ability of the members of the city councils in most of the smaller towns, he called attention to the fact that the electric lighting business is one which calls for constant care, knowledge of the business and watchfulness to obtain any sort of good financial results. All the operators in the room could bear him out in this statement. Was it reasonable to suppose, therefore, that this attention would be given to a municipal lighting plant by the members of a city council who had their regular business interests to look after and to whom the city's affairs must necessarily be a side issue? It was out of the question for them to give attention to all the details of the city's business. It was up to the central station men to marshal the facts about municipal ownership and present them to the public.

In a plant supplying current for lighting much of the invest- the interest and depreciation goes on twenty-four hours every day. The short hour lamps must carry interest charges on the whole day, and not simply those of the hours they are burning. Lack of consideration of these facts had led municipalities to give in some cases absurdedly low rates, which resulted in the electric lighting plant being operated at the expense of the taxpayers, rather than at the expense of those using the light. Numerous quotations were made from recent issues of the ELECTRICAL WORLD AND ENGINEER giving municipal ownership figures. The paper was enthusiastically received and has been copied by a number of daily papers.

A paper on "Meter Data" was read by Mr. A. W. Reavy, of Davenport. He condemned the flat rate system of charging, which is still in far too common use, and called attention to the loss of revenue through slow meters to the companies which are careless about meter testing. He enumerated the requirements of a good meter, among which is one that a meter should be as nearly dustproof as possible, because of the long time it must stay out without cleaning. Dust and dirt are the principal causes of meters running slow unless they are unduly worn. The meter should preferably be one in which short circuits would have a minimum effect on the permanent magnets. Excessive current flowing through the series coils of the meter during short circuit sometimes weakens the magnets so as to cause the meter to run fast. The only way to repair meters injured in this way was to take out the magnets and remagnetize them after having first aged them by striking with a hammer and heating to the boiling point of water. He advised keeping on hand a full stock of repair parts for meters, and also urged the keeping of the meter department very clean and free from dust. Constant vibration where a meter is located sometimes makes it run fast. He advocated providing customers with printed directions on the reading of meters. He also referred to the extensive use of prepayment meters by his company in Davenport, which had met with marked success, as was before referred to in discussion.

The report of the committee on "Facts and Factors" was made by Mr. Austin Burt, of Waterloo. He outlined a plan or form of report by which he hoped during the next year the committee might be able to collect data of value for comparison among Iowa central stations. The outline he suggested was rather general because so few stations go into a minute analysis of operation. However, if even the few standards he suggested could be adhered to and information furnished on these, it would be a great help. He therefore suggested the following outline of a report to the committee on "Facts and Factors":

Population of district served. Under this towns would be placed in four classifications. Class A—Stations in towns of less than 5,000 inhabitants, of which there are 165 in Iowa. Class B—Stations in towns of from 5,000 to 25,000 inhabitants, of which there are 20 in Iowa. Class C—Stations in towns of 25,000 to 100,000, of which there are four in Iowa. Class D—Stations in cities of over 100,000.

Total permanent investment, per capita of population. (For example, $10.)

Capital investment per kilowatt of maximum station capacity. (For example, $250.)

Gross income per annum, under which should be given:

Gross income per capita. (For example, $2.25.)

Gross income per $100 invested. (For example, $20.)

Gross income per kilowatt maximum station capacity. (For example, $50.)

Gross income per 50-watt lamp or equivalent. (For example, $3.)

Number of 50-watt lamps or equivalent per capita.

Fixed expenses (to include all expenses which would not stop if no current were sold).

Other expenses:

Ratio of operating expenses to gross income. (For example, 65 per cent).

Ratio of fixed expenses to other expenses. (For example, 60 per cent).

Net earnings:

It was his idea that this data be collected by the committee and that the information obtained on certain items be given only to the stations reporting figures on the same items. This would be perfectly just, and would prevent companies obtaining information which they had not paid for by giving information in exchange.

Mr. George S. Carson, of Iowa City, read a paper on "Association Matters," calling attention to the benefits to be derived from membership in the association. Compiling of rates charged by central stations in various towns of the State had been of great benefit to many members when questions of adjustment of rates came up in city councils. The association was of especial benefit to the small stations which must figure very close in operation and cannot afford the high-priced advice which the large stations can purchase in the open market. He advised every member to go home with the determination to see how much information about his own station could be reported next year.

The convention then went into executive session and elected as officers for the ensuing year: Austin Burt, of Waterloo, president; A. W. Zahm, of Mason City, vice-president; P. E. Bellamy, of Knoxville, secretary; A. Moll, of Belle Plaine, treasurer. The Executive Committee consists of George S. Carson, of Iowa City; L. D. Mathes, of Dubuque, and J. A. Innes, of Eagle Grove. The resignation of Secretary Porter was accepted with much regret, as he is about to leave the State for a time. He has been secretary of the association during the five years since it started, and as is frequently the case, the success of the association has depended much on his work.

The by-laws were amended to change the annual dues of companies operating in cities of over 5,000 inhabitants, as mentioned earlier in this report. Des Moines was selected as the next place of meeting. Invitations to meet at Davenport, Burlington and Ottumwa were received, but on account of the central position of Des Moines it was thought that it was not wise to jeopardize the attendance by meeting elsewhere than at the State capital, which is convenient to all parts of the State.

At the close of the convention a very hearty vote of thanks was passed and many warm words were spoken in commendation of the hospitality of the Union Electric Company, of Dubuque, as carried out by Mr. L. D. Mathes, general manager, and Mr. J. R. Lindsay, secretary. The convention was certainly royally taken care of and all details were carefully looked after.

## English View of American Education.

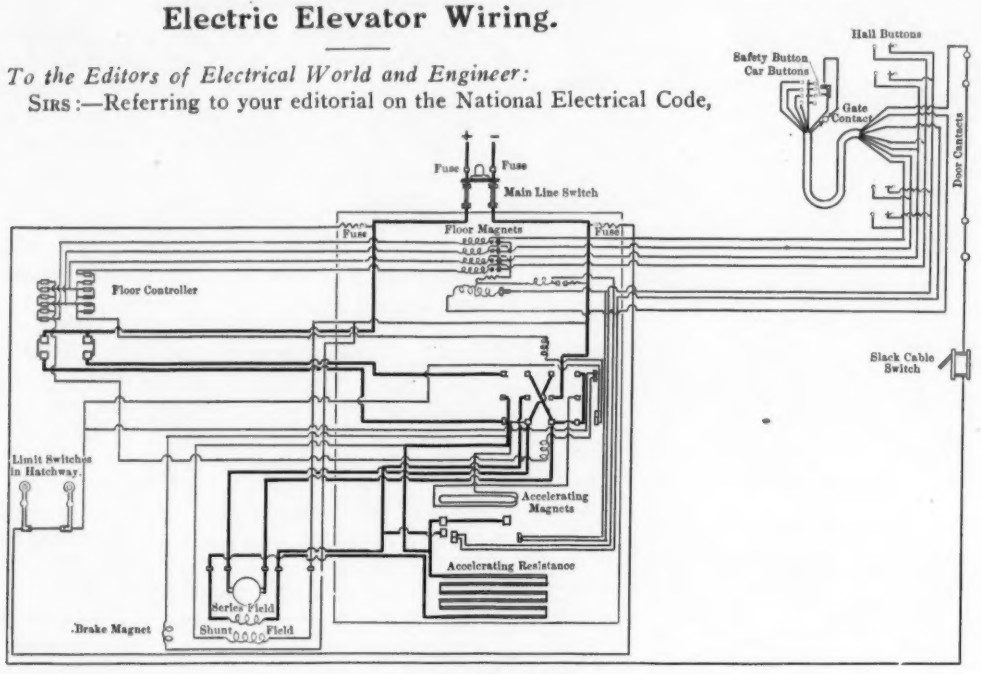
In a recent address, Mr. Arthur Moseley, who a few years ago sent a commission to this country to report on American systems of education, said that the secret of America's industrial success lay in her system of education. There it was customary to teach four "R's" instead of three as in England, the fourth signifying "Reason." Every child was taught to reason and to think for itself instead of learning by rote. Education had done more for America than all the natural resources had done for England. The entire system of English education was wrong, because it did not make every child self-supporting and capable of rising to almost any position in the world. He had met would-be office boys in England who had passed through Board schools and were not able to do arithmetic—they could barely write their own names. In justice, he confessed that American boys stayed longer at school, but then in that country all education was free, even including the universities.

# LETTER TO THE EDITORS.

## Electric Elevator Wiring.

*To the Editors of Electrical World and Engineer:*

SIRS:—Referring to your editorial on the National Electrical Code, the rules of the Code, No. 14 wire must be used for all the shaft wiring. As seen, a wire passes up the shaft through the contacts of the automatic door locks, thence to the safety push buttons in the car, through the gate contact and back to a magnet on the machine controller, whence a wire passes up through the shaft and through each of the hall push buttons in turn, and another wire parallels it up the shaft, but runs to the car push buttons, instead of those in the hall. The remaining wires are the return wires from the car and hall push buttons.




WIRING DIAGRAM.

I enclose herewith a typical wiring diagram of an automatic electric residence elevator, and would call attention to the fact that, under

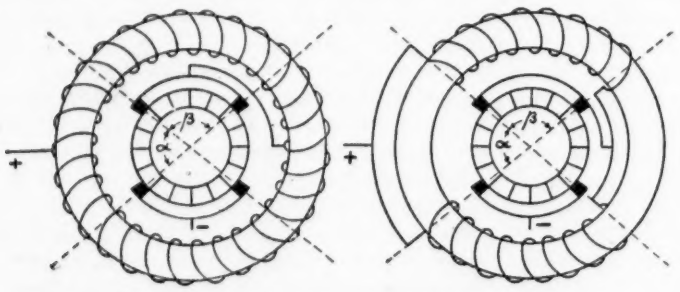
On account of the employment of resistances which can be varied for the different voltages, the current in any one of these wires is always less than one-half ampere, and there seems no objection to the use of No. 16 flexible wire. There are two reasons why it would be desirable to permit this. First, the elevator shafts in residences are frequently so small that every fraction of an inch obtainable must be used for the car, and the size of the conduits and the junction boxes must be a minimum. Second, No 16 wire is easier to handle in making connections to door contacts, push buttons, etc., which work is really comparable to fixture wiring.

NEW YORK. F. E. TOWN.

# DIGEST OF CURRENT ELECTRICAL LITERATURE

### DYNAMOS, MOTORS AND TRANSFORMERS.

*Compensated Repulsion Motors.*—DANIELSON.—A paper on the best arrangement of the windings and of the brush position for compensated repulsion motors. Fig. 1 shows an arrangement of Latour,




FIGS. 1 AND 2.—COMPENSATED REPULSION MOTORS.

who uses a position of brushes which is favorable with respect to commutation, and which, according to the present author, also has the advantage that the distribution of the current in the rotor is the same as though it was only partially wound. His stator is completely wound. The short-circuit current flows in the armature only between the short-circuited brushes corresponding to the angle $\beta$, while the compensated current flows only through the windings corresponding to the angle $\alpha$. The author states that it is more advantageous to wind only those parts of the stator which correspond to the angle $\beta$, as shown in Fig. 2. The result is that the efficiency is increased and that at starting the torque per volt-ampere is also increased. The angle $\alpha$ should be made a little greater than 46°, say between 46 and 60°, in order to get the best conditions with respect to the heating and the stray field.—*Elek. Zeit.*, April 6.

*Voltage Drop in Transformers.*—BARRERA.—An illustrated paper read before the Italian Electrical Association, in which he discusses three methods of measuring the voltage drop in transformers. One is due to Kapp, the second to Feldmann, the third to himself. Kapp's method is the simplest and requires only one transformer, but leaves some uncertainty. His and Feldmann's methods require two equal transformers, and Feldmann's method is the more complicated, yet the more exact of these two. The vector diagram is given and explained.—*L'Eclairage Elec.*, March 25.

*Inverted Rotary Converter.*—CLINTON.—An abstract of a British Physical Society paper on the voltage ratio of an inverted rotary converter. The values of the voltage ratio usually given for an inverted rotary converter make no allowance for the resistance of the armature. In the present note, terms due to the effect of armature resistance were introduced into the ordinary theoretical equations. The resultant voltage on the alternating-current side is found to be less than that given by the usual rule. The calculation is made only for open-circuit conditions on the alternate-current side. No further details are given in the abstract.—Lond. *Elec.*, March 31.

### LIGHTS AND LIGHTING.

*Mercury Arc Lamp.*—STRAUSS AND SCHIFF.—Two papers read before the Electric Society of Vienna. Strauss gave a review of recent developments in mercury arc lamps, and dealt at some length on the use of fused quartz (silica) for mercury arc lamp construction. Quartz glass has a melting point 800° higher than ordinary glass. With quartz glass lamps it is possible to use a higher drop of voltage per unit of length and to decrease the cross-section, whereby the light intensity is essentially increased. While in the Cooper Hewitt lamps the voltage drop is 0.7 volt per cm., it is 4 volts per cm. in the quartz glass lamp. No lamps are broken due to softening of the glass or to sudden cooling after the circuit is opened. On account of the high temperature of the electrodes, the current is introduced through iridium wire. However, the coefficient of expansion of iridium is greater than that of quartz glass. For this reason a certain paste is used around the point where the wires are fused into the quartz glass. The ultra-violet light, which is emitted from the quartz glass lamp in large quantities, causes a considerable ozonization of the surrounding air and has also a strong dissipating effect on negative charges. The author thinks it would be promising to undertake again experiments with Zickler's light telegraphy with the use of large quartz glass lamps. The efficiency of the quartz glass lamp is lower than that of the ordinary mercury vapor lamp. The latter consumes about 0.4 watt per candle, the former 1.1 watt

per candle. The author shows that the ordinary mercury vapor lamp, if it consumes 0.5 watt per candle, is 25 times more economical with respect to the consumption of energy than the Welsbach gas light. Schiff spoke on the use of the mercury vapor lamp for physiological and therapeutical purposes. For this purpose the quartz glass lamp is specially suitable on account of the large amount of ultra-violet rays emitted. These rays are extremely energetic, but the effect is limited to the surface, since the ultra-violet rays do not penetrate into the interior, and are absorbed by the outside film of the skin. In the discussion Winkler remarked that the quartz glass lamp is not without danger and should be used with care on account of the physiological effects. Sahulka referred to experiments made by him in 1894 and 1898 in order to use the alternating-current arc lamp as rectifier. He experimented with electric arcs in ordinary atmosphere between different electrodes, among them iron and mercury, as well as carbon and mercury. He believes that these arcs are very similar to those formed in the vacuum of the mercury vapor lamp, and might also be used for therapeutic purposes. Such an arc lamp would have the advantage of avoiding the somewhat complicated starting device, and of saving the large expense for quartz glass, since no tube whatever would be required.—*Zeit. f. Elek.* (Vienna), March 5.

*Modern Arc Lamps.*—HOWATT.—The general supposition that arc lamp development has been practically at a standstill for many years is an erroneous one. No radical changes have been made, of course, and any changes that have occurred have been made in the details of manufacture and operation. The author gives the prerequisites of an ideal arc lamp, and shows that the modern arc lamp does not fall far short. The different types of arc lamps as they are manufactured and supplied to the trade are described. These include all the modern general types.—*Am. Elec.*, April.

## POWER.

*Electric Power in Collieries.*—BROWN.—A paper read before the Rugby Engineering Society. The tests of Heise and Thiem have shown that incandescent lamps broken in an explosive atmosphere are not a source of danger unless the current exceeds 0.6 ampere. The result holds good for both direct and alternating current at pressures up to 220 volts Tests by the same authorities have also indicated that slight sparking and glowing at the brushes of a direct-current motor will not ignite an inflammable mixture, but if a motor is subjected to sudden overloads or the commutation is bad there will certainly be an explosion. Switches and fuses of the type ordinarily used on direct-current circuits are decidedly dangerous. Practically the only circuit which can be broken safely by an open switch is one supplying lamps which take not more than 0.6 ampere. All other switches must be totally enclosed in strong cast-iron cases, made as nearly gas-tight as possible. Even then switches and fuses are a source of danger when used for carrying large currents. The greatest advance in the application of electricity for mining purposes has been due to the introduction of the polyphase alternating current induction motor. If motors with slip-rings (in cases where squirrel-cage construction is out of the question) are provided with two brushes for each slip-ring it is practically impossible to produce a dangerous spark by any ordinary means short of lifting both brushes at the same instant It is advisable, however, to have the slip-rings totally enclosed, if only to afford mechanical protection. Such a motor is practically as safe as one with a squirrel-cage rotor, and has the advantage that full-load torque can be obtained at starting with a current not greatly in excess of the normal full-load current. One of the chief advantages of an alternating-current plant for mining work lies in the fact that all the switches can be of the oil-break type, and the use of fuses is not necessary. He then discusses the use of an alternating-current system for winding, and points out its inherent economy over steam engines for winding. The Ilgner system is referred to. In the case of large winding gears connected to a power station situated very near the shaft, the most promising and most economical plan seems to be the installation of a separate engine and dynamo for supplying current to the winding-gear motors. The engine should, if possible, be of the high-speed type, arranged to work with constant steam admission and provided with a governor which will come into action only when the speed of the set exceeds a certain safe limit. The engine practically replaces the induction motor in the case of the Ilgner set, the other parts, including the heavy fly-wheel, compensated generator and exciter, remaining the same. One of the principal applications of electricity in mines is for driving pumps. Within the last year the use of high-lift turbine pumps has considerably increased; they are especially suitable to three-phase induction motors.—Lond. *Elec.*, March 17.

*Power in Ship-Building Works.*—A continuation of the illustrated description of the electrical equipment of Harland & Wolff's ship-building works. Variable-speed motors with controllers specially designed either for one or two voltages are being installed to a considerable extent, especially in connection with the lathes. One of the most interesting examples of electric driving is the application of a variable-speed motor to a planing machine, the accelerated speed for the return stroke being provided by the motor itself directly, without the usual complication of the straight and crossed belt. The switches shown diagrammatically in Fig. 3 are driven from the main and the "kicker" shaft of the planer. The switch driven by the kicker shaft reverses the motor at the end of the cutting stroke, and then the

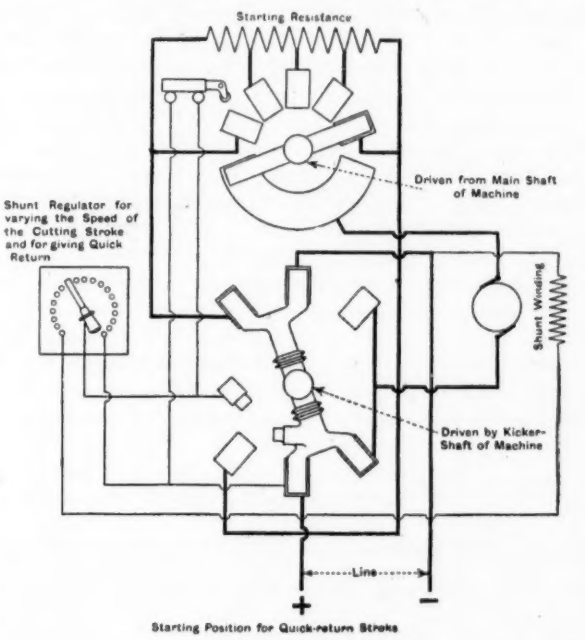

Starting Resistance
Driven from Main Shaft of Machine
Shunt Regulator for varying the Speed of the Cutting Stroke and for giving Quick Return
Shunt Winding
Driven by Kicker-Shaft of Machine
Line
+
−
Starting Position for Quick-return Stroke

FIG. 3.—WIRING DIAGRAM.

switch driven by the main shaft immediately inserts a resistance in the field circuit, which raises the speed. At the end of the return stroke, this resistance is short-circuited, to provide a strong field for reversal of the armature current. Curves are given which show the cycle during actual working conditions with the new method and the cycle of the same machine working formerly with straight and cross belts. With the new method, less energy is lost on the reversals.—Lond. *Elec.*, March 31.

*Steam Turbo-Generators.*—LONDON.—An illustrated paper read before the Manchester Section of the (Brit.) Inst. Elec. Eng., on the mechanical construction of steam turbines and turbo-generators. He dealt mainly with the Westinghouse turbine. In the discussion Whysall referred to two 1,800-kw turbines installed at the Dickinson Street works of the Manchester Corporation, and mentioned that a 2-lb. brass-wire brush lasted only 336 hours. Commutation was the weak point. Compensating devices are about to be adopted, and with a fixed brush position there is bound to be a great improvement.—Lond. *Elec.*, March 24.

*Fuel Value of Coals.*—PARKER.—An article on the coal testing work carried out at the St. Louis Exposition. The general equipment and organization of the plant, the manner of making the tests and the chemical and steam raising trials are summed up.—*Eng'ing Mag.*, April.

*Niagara Falls.*—A fully illustrated description of the headworks of the plant of the Toronto & Niagara Power Company, of Niagara Falls.—*Eng'ing Rec.*, April 8.

## TRACTION.

*Manchester Equalizing Traction Load Curve.*—GUNTON and PEARCE.—A paper read before the Manchester Section of the (Brit.) Inst. Elec. Eng., on the Manchester tramways, which serve an area of 41 sq. miles, 144 miles of single track being equipped. The

authors give very full data on the power supply and curves of the variation of load on the different stations. To reduce the disadvantages of the variations of traction load, they offer the following general considerations. They first discuss the possibility of running stations in parallel on the lines. The method can be carried out by carefully adjusting the compounding of the generators in the various stations which supply the different areas in parallel, and it does, on the whole, tend to reduce the fluctuations of the load. On the other hand, it is more difficult to keep the drop of pressure in the rails within proper limits, and it is also difficult to guard against excessive loads being taken by any one station, especially on starting up after a general shutdown. A second method is the use of machines capable of dealing with momentary loads greatly in excess of their normal most efficient loads. In the case of synchronous motor-generators, the shape of the "V" excitation curve of the synchronous motor is, of course, of great importance in this connection. With regard to generators, compound-wound machines, such as are used for traction work, meet the required conditions well, since an increase in the load is accomplished by an increase in the strength of the field, which is just what is required for sparkless commutation. The synchronous sets of the Manchester sub-station have been found capable of successfully taking momentary loads up to 50 per cent in excess of their normal full-load capacity, though the normal overload capacity is only 25 per cent. The number of stations for supplying a given number of cars should be kept as few as possible. Where there are a number of cross routes, it is, of course, much easier to supply a large number of cars from one station without excessive drop in the rails or excessive outlay in mains than in the case of a single long route. Even in the case of a single long route, however, the area of supply can be extended by means of additional positive and negative feeders and boosters, and in some cases these will be preferable to installing a separate sub-station towards the end of the line. This, of course, is considering the matter entirely from a traction point of view. The Manchester sub-stations had to be arranged to suit lighting requirements as well as traction. Batteries, preferably with reversible boosters, may be used first at the power house in the case of a direct-current station supplying a small number of cars; second, at the sub-stations in the case of an extensive system supplying a large number of cars. As a rule, however, it is only in cases where reliability is the governing condition that the cost of providing batteries of the necessary sizes at the substations is justified.—Lond. *Elec.*, March 10, 17, 24.

*Electric Automobiles.*—CHAMBERS.—A paper read before the Brit. Automobile Club, in which the author discusses the commercial future of the electric carriage in its present form. When the limitations of the accumulators are understood and recognized, little or no difficulty arises from their becoming exhausted. With an effective range of from 25 to 35 miles upon one charge, and with the adoption of interchangeable batteries, a carriage may be run all day, if only time be allowed for its return to a depot to take up a new battery, an operation which takes from two to three minutes. The far-reaching importance of this system of rapidly exchanging an exhausted battery for a fully charged one cannot be too much insisted upon. It will probably have a material effect upon the future of the electric carriage. Even with a garage in the most expensive and central position of London, the total costs per year are considerably less than they would be in the case of a horse-drawn carriage giving a similar degree of luxury. When the electric carriage is used to its full extent, the costs are very considerably less. Accumulator renewals have been reduced by organization and careful treatment to a figure equal to, if not below, that of the cost of tire renewals, and in other respects the mileage costs of the electromobile will compare favorably with that of other machines. He says that the electric carriage will be neither the touring car of the future nor the omnibus, and that the "hackney cab" constitutes another very difficult problem. For commercial vehicles the question of the required range of action is the dominant factor. Given a limited distance and suitable roads he sees no reason why the electric carriage should not have a very considerable future in this field, nor why the light delivery van for town use should not be accumulator driven. Here the conditions are very suitable. Town ambulance work is essentially the province of the electric car. The automobile which takes the place of the "smart horse-drawn carriage" will remain electrically driven.—Lond. *Elec. Rev.*, March 24.

*Interurban Railway.*—An illustrated description of the Columbus, Newark & Zanesville electric railway, which is a 27-mile easterly extension of the Columbus, Buckeye Lake & Newark Traction Company's line, the two connecting Columbus and Zanesville, Ohio, which are 65 miles apart. The new road traverses a very rocky territory, which made necessary some interesting departures from ordinary methods of construction. Three-phase currents are transmitted at 13,200 volts to two sub-stations, containing transformers and synchronous converters.—*St. R'y Jour.*, April 15.

## INSTALLATIONS, SYSTEMS AND APPLIANCES.

*Automatic Earth-Testing Device.*—A description of an old device of Wallis-Jones which has been successfully used in connection with self-contained installations, giving warning of undue leakage at any time of the day or night. The arrangement is shown in Fig. 4. *A* is

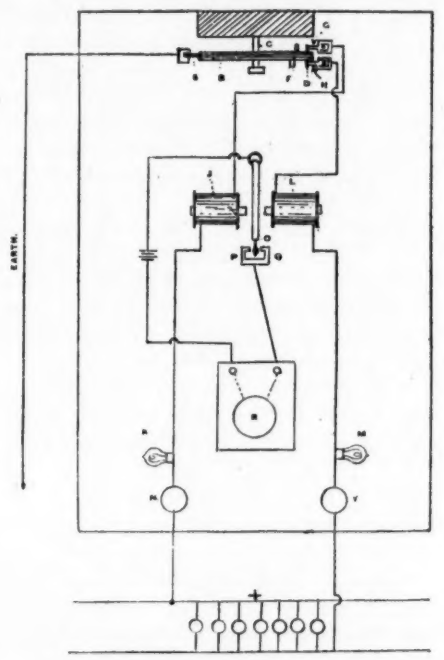



FIG. 4.—AUTOMATIC EARTH-TESTING DEVICE.

a clockwork arrangement which rotates the drum, *B*, through the spindle at *C* at any predetermined speed. The drum, *B*, which is permanently connected to earth by the rubbing contact, carries three studs, which come into contact with contact springs consecutively. One stud, *D*, makes contact with both of the said contact springs, *G* and *H*, at the same time, thus connecting them together; the stud, *E*, comes in contact with the contact spring, *G*, only, and in the same way *F* comes into contact only with the contact spring, *H*. *G* is connected through an electro-magnet, *J*, an incandescent lamp, *K*, and a fuse, *N*, to the positive wire of the electric light circuit, and in the same way *H* is connected through another electro-magnet, *L*, an incandescent lamp, *M*, which burns equally bright in series with the lamp, *K*, and through a fuse, *Y*, to the negative wire of the electric-light circuit. The electromagnets, *J* and *L*, actuate a tongue, *O*, which completes a local bell circuit, *R*, when touching either of the contacts, *P* or *Q*. It will be seen that, as the drum, *B*, rotates, the stud, *D*, makes electrical contact with the contact springs, *G* and *H*, thus putting the lamps, *K* and *M*, in series, and at the same time putting the middle of the lead between the lamps to earth through the contact, *S*. If the insulation is perfect both lamps will burn with equal brilliancy, but supposing the insulation on either lead is defective the lamp on that lead will burn with less brilliancy than the other; also there being more current through one of the electromagnets, *J* or *L*, the tongue, *O*, will be attracted to one of the stops, *P* or *Q*, completing the local bell circuit, *R*, and giving warning of the defective insulation. Then as the drum, *B*, continues to rotate, the stud, *D*, passes the contact springs, *G* and *H*, and the leads are tested separately to show distinctly in which lead there is a deficiency of insulation. The stud, *E*, coming into contact with the contact spring, *G*, puts to earth the positive lead through the brush, *S*. If there is no leak on the negative there will be no current through the lamp, *M*, and it will not be incandescent; but if there is a leak the lamp lights up and the bell is rung by attraction of the armature, *O*; in the same way, on the further rotation of the drum, *B*, the positive lead is tested by the stud, *F*, coming into contact with the spring,

*H*, and earthing the negative lead. In the same way a static voltmeter or electrometer could be used in conjunction with the automatic connection for making contact.—Lond. *Elec. Rev.*, March 24.

*Lightning Arresters.*—Neall.—An illustrated article in which the author first defines the "equivalent spark gap" and its use in the development of lightning arresters. He then describes the multiple path arrester, which consists essentially of small air gaps in series with a specially prepared block of carbon called the discharge block, which may be conceived of possessing a great number of conducting particles suspended in an ordinarily non-conducting medium. With the advent of a static discharge there is no opposition to its passage, but the generator current cannot follow. It is on this remarkable characteristic that the arrester is founded. The discharge block is so shaped that the length of the path is short compared to the surface presented for discharge. The electricity spreads over the whole surface and divides itself into a great many separate paths, from which the arrester has derived its name, "multi-path."—*Elec. Club Jour.*, April.

*Electric Lighting of a Large Hall.*—Krueger.—A paper on the electric lighting installation of the large municipal hall in Essen, Germany. Besides the main plant of 1,282 alternating-current incandescent lamps and 19 alternating-current arc lamps, there are 124 emergency direct-current incandescent lamps and 10 direct-current arc lamps, the total power consumption being 96 kw. The main lamps are fed from a transformer which is supplied with current from the outside three-phase mains. In the building itself a storage battery of 324 ampere-hours, for a 108-ampere discharge current, and a 14-kw converter are provided. The 124 emergency incandescent lamps are fed from the battery, the 10 direct-current arc lamps from the converter. For power purposes, especially ventilators and elevators, 25 induction motors, having a total of 62 hp, are provided.—*Elek. Zeit.*, March 16.

## Electrophysics and Magnetism.

*Dielectric Viscosity.*—Corbino.—The quantity of electricity on the armatures of a condenser subjected to a potential oscillating in a sinusoidal manner is retarded with respect to the electric field. This phenomenon, known as dielectric viscosity, has been investigated by Corbino with sine currents of frequencies ranging from 2,000 to 4,000 per second. For this purpose he attached to the poles of an arc the somewhat complicated combination of condensers and inductances shown in Fig. 5. On increasing the intensity of the feeding current and short-circuiting the arc, the Duddell currents circulating in the shunts gradually approached the perfect sine shape. With a paraffined-paper condenser he obtained a lag of more than 2 deg. This lag is not due to a fault in the insulation, since the resistance was 10,000,000 ohms instead of 1,400 ohms, as it would have to be to explain the lag. The author supports the theory of Hess, but extends it by supposing that dielectrics contain two kinds of conducting particles, one kind possessing a greater mobility than

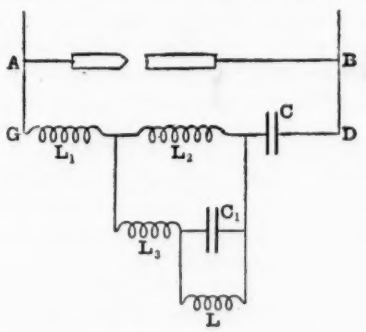



FIG. 5.—TESTING VISCOSITY.

the other. The different kinds would be brought into vigorous action at very different frequencies.—Lond. *Elec.*, March 24; from *Phys. Zeit.*, March 1.

*Origin of Radium.*—Boltwood.—A paper giving a large amount of experimental evidence confirming the observation formerly made by him that the quantities of uranium and radium which occur together in certain minerals are directly proportional to one another. He draws "the inevitable and only possible conclusion" that uranium is the parent of radium. The persistent appearance of lead as a constituent of uranium-radium minerals is thought to indicate that this element is one of the final (inactive) products of the disintegration of uranium.—*Phil. Mag.*, April.

*Action of Radium Rays on Conductivity.*—An account of measurements of the effect of radium rays on the conductivity of bismuth, iron, steel, copper, platinum, brass and German silver. The uniform result obtained was an increase in the resistance beginning immediately on exposing the wire to the action of radium rays.—Lond. *Elec.*, March 24; from *Comptes Rendus*, March 6.

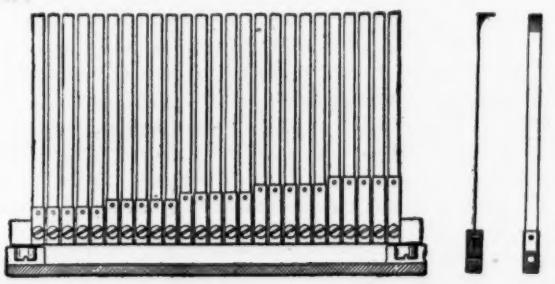
*Point Discharges.*—Ewers.—An account of a long series of experiments with point discharges in helium, argon, hydrogen and nitrogen. He found the following law: The product of minimum potential and square root of mean free path, divided by the number of atoms in the molecule, is constant for all the four gases at the same temperature and pressure. Combining this with a law governing the relation between current and e.m.f., he deduced the more general law that for a given e.m.f. the current is simply proportional to the mean free path of the molecules. This corresponds to the fact that in metals the conductivity is proportional to the mean free path of the electrons.—Lond. *Elec.*, March 24; from *Phys. Zeit.*, March 1.

*Ionization in Flames.*—Massoulier.—An account of a study of the ionization in flames by means of vertical electrodes placed symmetrically with regard to the flame, so as to avoid the distortion produced by the upward current and by differences of temperature. He found the current sensibly independent of the distance between the electrodes. This tends to show that the ionization takes place, not so much at the surface of the electrodes as throughout the volume of the flame.—Lond. *Elec.*, March 24; from *Comptes Rendus*, March 6.

*Dielectric Strength, Capacity, Resistance of Mica.*—Wilson and Mitchell.—An account of tests of 17 different specimens of mica. The dielectric strength in maximum volts $\times 10^6$ per centimeter varied between 0.27 and 2.5, the specific inductive capacity between 2.5 and 5.9, the specific resistance in $10^{12}$ ohms per c.c. between 0.44 and 133.—Lond *Elec.*, March 17.

## Units, Measurements and Instruments.

*Measuring Speed.*—Lux.—An illustrated paper on the new speed meter by Frahm, which is based on the phenomenon of resonance. As shown in Fig. 6, it consists of a number of steel teeth, assembled in a frame, the construction of each tooth being shown in Fig. 7.



FIGS. 6 AND 7.—MEASURING SPEED.

Each tooth is made of good steel, such as is used for watch springs, and is 0.25 mm. thick, 3.0 mm. broad and 40 to 50 mm. long. The lower end of each tooth is firmly embedded in a solid shoe, while the upper end is bent, a drop of soldering tin being fixed in the crease. By using teeth the oscillating length of which is between 40 and 50 mm., and by varying the quantity of tin applied to them, it is possible to tune them to any frequency between the limits of 35 and 100. The one tooth which in the comb of Fig. 6 begins to oscillate, gives the frequency of the oscillations which set it in motion. The simplest way is to fix the apparatus directly on the frame of the machine the speed of which is to be measured. In general, the oscillations of the frame and bearings are strong enough to actuate the device. If this is not the case it is sufficient to mount on the axle of the machine a disc with an irregular circumference. Against this disc is made to slip a lever which transmits the oscillations to the comb device. For measuring the speed at a distance an electrical transmission method may be used. On the frame of the comb device a piece of soft iron in form of a flat plate is mounted, which forms the armature of an electromagnet, as shown in Fig. 8. By passing an alternating current through the coils of the electromagnet the armature is set in regular oscillations and actuates that

tooth of the comb device which is tuned to this frequency. If, for instance, the speed of an alternator is to be measured, it is sufficient to feed the electromagnet of Fig. 8 with the current of the alternator. If the speed of another machine is to be measured, a small alternating-current generator is mounted on its axle; it may consist simply of a toothed soft-iron disc rotating before the pole shoes of a permanent magnet, which is provided with a winding.—*Elek. Zeit.*, March 16.

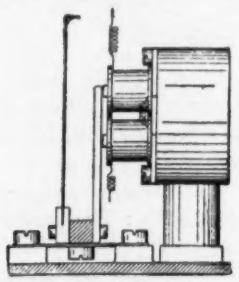


FIG. 8.—MEASURING SPEED.

*Recorder of Atmospheric Ionization.*—NORDMANN.—A description of a new apparatus for registering the ionization of the atmosphere. The apparatus consists essentially of a cylindrical condenser filled with the air whose ionization is to be determined. The outer cylinder is kept at a fixed potential by means of a battery. The inner one is connected with the earth, so that there is from the condenser to the earth a constant current whose intensity depends simply upon the ionization of the air. To measure this current, the author makes the connection with the earth not by a wire, but through a jet of water connected with the inner cylinder. The number of drops per second can be accurately regulated, and, as their size is constant, they will take away a charge proportional to the potential of the inner cylinder. This, again, depends upon the ionization, and thus if the potential of the inner cylinder is measured it will at any instant indicate the degree of ionization. The inner cylinder is, therefore, connected with one pair of quadrants of an electrometer whose other pair is earthed and whose needle is charged. The deflection of the needle is then proportional to the ionization, and is continuously registered by a photographic cylinder.—Lond. *Elec.*, March 24; from *Comptes Rendus*, February 13.

### TELEGRAPHY, TELEPHONY AND SIGNALS.

*Tuning of Thermo-Electric Receivers for Electric Waves.*—COLE.—An account of experiments in which he used exciters of a modified Righi type, the two central spheres of the usual form being replaced by thin cylinders with rounded ends, the separating oil-gap being very small. The receiver was made of the same form and diameter as the exciters, but it had a variable length and a thermo-junction of fine iron and constantine wires replaced the spark-gap. The conclusions obtained by the author are as follows: When a thermal receiver of linear form is used in connection with a Righi exciter, interference curves show the wave length characteristic of the receiver. When the receiver length is changed until a distinct maximum effect is produced from a given exciter, it is probable that the fundamental wave length of each is the same, and an interference experiment will then (and only then) give the wave length of the exciter. The ratio of measured wave length to receiver length, as shown in five measurements, is 2.53, 2.51, 2.65, 2.45 and 2.47, respectively; mean, 2.52. This agrees well with the value determined theoretically by MacDonald (2.53) and not with the value 2.0, given by Poincaré.—*Phys. Rev.*, April.

## BOOK REVIEW.

CONTRÔLE DES INSTALLATIONS ÉLECTRIQUES. By A. Monmerqué. Second Edition. Paris: Ch. Béranger. 775 pages, 226 illustrations.

This volume is a sort of textbook of electric installations for the distribution of electric light and power, written from the standpoint of municipal supervision, inspection and control. Since the usual textbook deals with such installations from the standpoint of a constructor, or of a designing engineer, the contrast of viewpoint gives this volume a special interest and importance. It is edited and developed by M. Hippolyte Fontaine. It is the most valuable book from the above-mentioned standpoint that has yet come to our notice.

The first five chapters of the work are strictly electrotechnical and present the laws of applied electromagnetism in textbook fashion, illustrated in many instances by numerical examples. The remainder of the book is mainly devoted to the tests and supervisory codes of rules under which installations are laid in France. Notice is also taken of the procedure in other countries. A very full set of municipal regulations is appended relative to electric installations in Paris.

The volume will be found of great value to those who are interested in municipal electrical undertakings.

## Electric Cooking.

In order to promote the sale of electric cooking and heating apparatus in and around the city of Philadelphia, the Philadelphia Electric Company arranged for a special meeting on the subject for its district managers and solicitors on April 11, when a lecture on electric cooking and heating was delivered by Mr. Max Loewenthal, secretary and electrical engineer of the Prometheus Electric Company, New York. Mr. Loewenthal showed by experiments the historical development of the electric heating industry and presented to those present considerable valuable data of a practical nature relating to this subject.

During the course of the evening a complete meal was prepared by means of Prometheus electric cooking apparatus by Miss Helen Tovell, a graduate of the Lemcke School of Cooking, and handsome menus were presented to those present. A large number remained after the lecture to partake of the meal prepared.

## Bijur Storage Battery.

Of the immense amount of work that has been bestowed on the storage battery, the greater part has been in attempts to develop forms differing radically in principle or structure from what previous experience had appeared to indicate as the natural types of battery fixed by all of the conditions applying. Even when the object in view was the correction of deficiencies in these types, the tendency has been toward radical changes rather than to working out improvement along common-sense lines involving a consideration of all of the factors entering. In developing the type of battery described below, the inventor, Mr. Joseph Bijur, retained the well-tried electrochemical combination of lead and sulphuric acid and the typical shape of plate, and devoted his attention to meeting all of the defects that experience had brought to light in the older forms. The work was not confined to changes in the plate, though in working the problem some radical changes were indicated, but included the invention of new processes of welding and also mechanical processes for turning out plates rapidly and of uniform quality.

With the collaboration of Dr. J. S. C. Wells, of Columbia University, in the earlier stages of the work, Mr. Bijur set out, in short, to produce a storage battery plate according to an ideal design which should be both mechanically and chemically perfect. This design embodied a rigid structure, freedom from tendency to distortion, perfect acid diffusion, active material incapable of being displaced, high specific capacity, high rates of charge and discharge, high efficiency, good regulation and freedom from "sulphation," buckling, or any other destructive action, save ordinary and unavoidable wear and tear.

These characteristics could exist only in a form of plate made up of small, finely subdivided structures each free to expand unrestrainedly and firmly welded to a strong supporting and conducting grid. The active portions decided on as most advantageous could not be produced at commercial cost by any known method, whereupon Mr. Bijur devised automatic machinery by which these parts are now made with great uniformity and at low cost.

By no method of metal working then existing was it possible commercially to weld together two elements, of which one was of heavy solid form and the other of very fine thin parts. It was, therefore, necessary to devise a new method of metal welding which, after much patient work, in the face of seemingly insuperable difficulties, was successfully accomplished, and for the carrying out of which on a commercial scale, an entire line of machinery was constructed on original lines.

The requisite quality and uniformity of oxide next received attention, with the result that, to secure the desired effects, a new process of formation was devised by which great toughness, porosity and other desirable qualities could be imparted to the oxide layer,

the whole process being perfectly reliable and at all times under the control of the operator.

The Bijur plates are composed of multiples of pure lead structures in the shape of gratings or "grills," as shown in Figs. 2, 3 and 4. These are welded to, and in one piece with, a stiff frame made of lead and antimony only. The weld goes clear through the plates and is produced without the use of tin, solder flux, or any extraneous material whatsoever. The frame merges into the grill without joint. At each end of the grill a space is provided for its elongation by expansion, and provision is made for expansion sidewise. The result is a plate having the stiffness, strength and inoxidizable support of the alloy grid, rigidly held active parts, yet complete provision for their expansion without the setting up of any strains that could produce buckling.

The grills are composed of a multitude of thin partitions open through from face to face. When in the untreated metallic state these grills are very open structures, having a large number of component partitions or ribbons running in the vertical direction, supported by heavier cross members running horizontally, which serve as conductors and give lateral stiffness. During the formation process part of the metallic lead is converted into oxide, which, by reason of the large increase in volume, nearly fills the openings. The

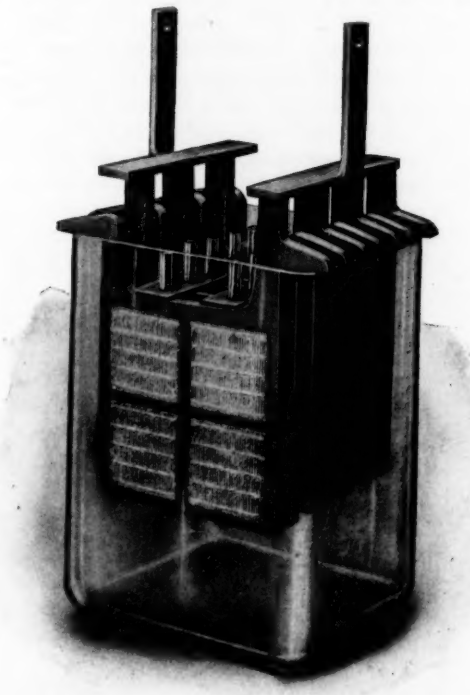


FIG. 1.—CELL COMPLETE.

ribbons on the positive elements have a large amount of metal left as a reserve for the oxidation which is attendant on the normal action of every storage battery.

When the oxide is formed in the rectangular cells, it assumes a slightly elliptical shape, which, expanding into the rectangular containing space, produces a locking in that is so positive that nothing short of destruction of the plate can dislodge it. At the same time, even when the oxidization is carried to the point of apparently completely filling the cells, the tendency of the ellipse to grow larger along both its axes, insures the presence of a minute slot through the centre of the oxide mass, which allows the flow of electrolyte to take place freely through it. The resultant oxidized plate, therefore, is rigid, the grills are firmly held, they expand without producing strains, each particle of oxide is firmly pressed against the lead from which it is grown, and the entire plate is open through and through to circulation and diffusion of the electrolyte.

Owing to the character of the design and the structure of the oxide formed, the plates possess several features hitherto unattained in battery practice. "Buckling" cannot take place, and so far repeated attempts to intentionally produce distortion have failed. Also, since the perfect diffusion through the plate prevents high acid concentration in the pores, deleterious sulphation does not take place even when an effort is made to produce it.

One of the important advantages gained by this form of design is that in a plate of given dimensions, 20 per cent greater capacity can be obtained with about 10 per cent. more reserve lead, than in any form of plate hitherto constructed. The fine sub-division of the oxide into small masses, combined with the fact that the surfaces of the plates are composed of ribbons on edge, precludes the possibility of blistering or shrinkage that is liable to occur when plates contain oxides in large masses.

The makers claim that owing to the rapid acid diffusion full

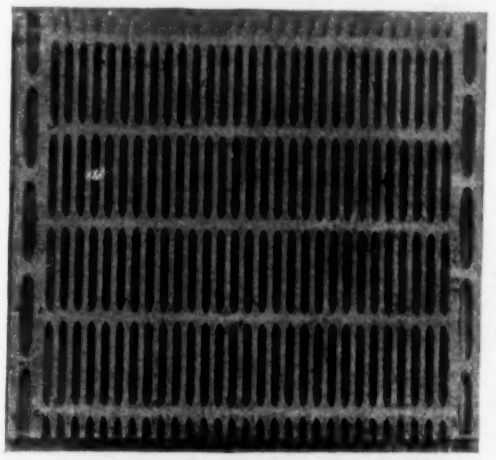


FIG. 2.—UNFORMED GRILL.

charge may be given the batteries at a voltage of 2.4 to 2.5 volts instead of 2.7 volts per cell, as is usually required. This low charging voltage results in increase of efficiency, and reduces the size of boosters required to charge.

The structure of the plate forms a conducting network to all parts, insuring equality of action all over its surface, and this, together with the facility for escape of gas without dislodging active material, favors the ability to stand very high rates of charge and overcharge without marked deterioration.

In short, since storage battery plates can be calculated out scientifically and then constructed in exact accordance with the design,

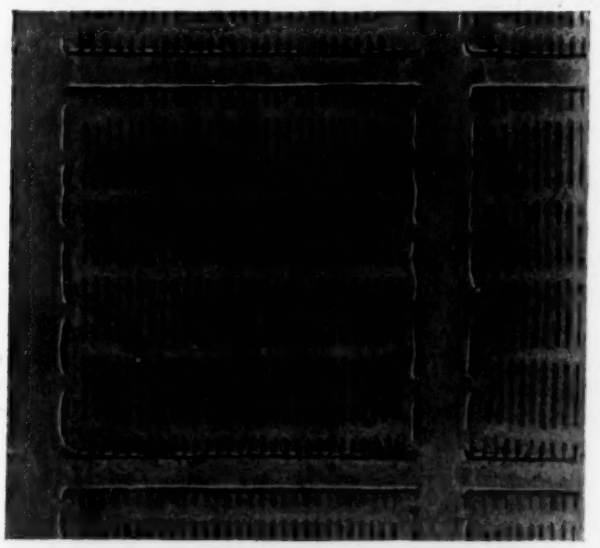


FIG. 3.—SECTION OF FORMED PLATE.

the series of developments and inventions of Mr. Bijur places the manufacture of storage batteries on the same basis as that of dynamo-electric machinery. These processes permit of any suitable forms of active parts and supporting frame-work being united into one integral structure at a low cost of production and without the introduction of any foreign substances.

The General Storage Battery Company, which is now putting elements of this type on the market under the name of the Bijur "High Duty" battery, has recently equipped a factory at Boonton, N. J., with special automatic machinery for the cheap and rapid production of storage batteries, where, by reason of an abundant and cheap hydraulic power and the automatic machinery used, storage

batteries of the highest grade can be produced, it is claimed, for a lower cost per kilowatt-hour capacity than is possible anywhere else in the country.

The company has also developed a new and complete line of automatic regulating boosters, end-cell switches, and other auxiliary

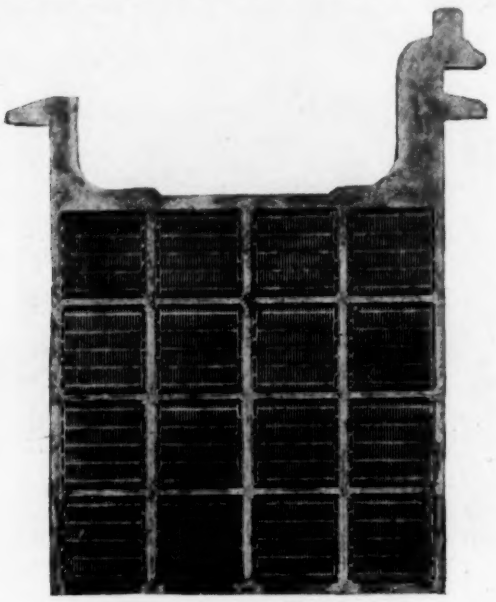


FIG. 4.—COMPLETE GRID.

apparatus for all classes of central station work and power plants. It may be said, however, that all of these devices differ as radically from the present known types, as does the Bijur "High Duty" battery from the conventional storage battery electrodes, and the improvement in methods and degree of regulation represents a marked advance in storage-battery engineering.

## Transmission-Line Towers.

The accompanying illustration shows one of the steel towers to be used on the transmission line of the Niagara, Lockport & Ontario

TRANSMISSION-LINE TOWER.

Power Company, between Niagara Falls and Lockport. The towers, which will be placed at intervals of 550 ft., are of tripartite construction, and very strong, the three legs being of 2½-in. tubing filled with concrete, and sunk 5 ft. below the surface of the ground in concrete footings. The insulators are of porcelain, and weigh 35 lbs. each. The total weight of each tower is 2,800 lbs.

The greatest possible side strain to which the towers will be subjected is 4,700 lbs., taking into consideration the weight of the cable, with a possible 1-in. coating of sleet and a wind velocity of 100 miles an hour. The towers are tested to resist a much greater pressure. The transmission lines are to be erected on private right of way, closely guarded so that the possibility of injury from the high tension current may be lessened. The Archbold-Brady Company, of Syracuse, N. Y., has secured the contract for the construction and erection of the first 400 of these towers, each of which will be 49 ft. high.

## New Westinghouse Apparatus.

For the purpose of determining the instant when the proper relation exists between the phase position and value of the e.m.f. of a synchronous machine when being placed in parallel with machines already in service, use has frequently been made of incandescent lamps. An inherent difficulty attending the use of the lamps is due to the fact that they do not indicate whether the speed of the incoming machine is above or below that of the machines in service.

A marked improvement in synchronizing apparatus was found in the synchroscopes. By their use it is possible to determine both the value and the direction of the phase difference, and to ascertain whether the speed of the incoming machine is too fast or too slow, and thus to determine the exact moment when the machines may be paralleled. The only limiting feature of the synchroscope is based

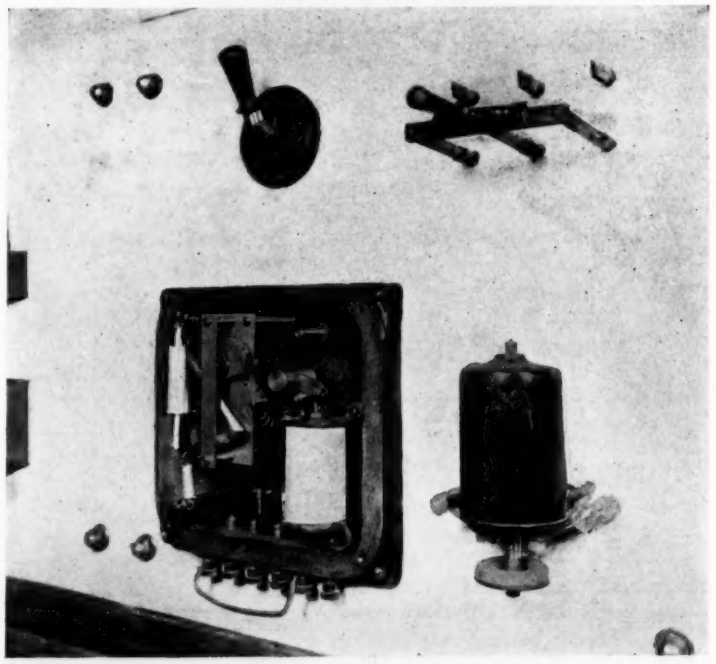


FIG. 1.—AUTOMATIC SYNCHRONIZER.

upon the fact that it is merely an indicating instrument, the actual work of paralleling being dependent upon hand operation.

The most recent development in this line of apparatus is embodied in the automatic synchronizer now being placed upon the market by the Westinghouse Electric & Manufacturing Company. The automatic synchronizer is applicable to installations using electrically operated or electro-pneumatic switches, and it is so designed that the contacts close at a predetermined time before the incoming machine reaches full speed, so that the switch will close at the instant synchronism is reached. Its adjustment may be changed to coincide with the time-lag of any particular form of switch which may be used. When it is used, machines can be thrown together with absolute safety with speeds varying to a much greater extent than is possible with hand operation. If the speeds of the machines vary too much, this instrument prevents the paralleling from taking place. The extreme accuracy and great labor-saving qualities of this instrument will be appreciated by all who have to do with the operation of rotary converters or alternators.

The synchronizer holds the contacts of the switch-operating cir-

close at synchronism, connecting the machines together. A controlling and relay switch is interposed in circuit with the synchronizer and electrically-operated switch. By means of the controlling switch, the main switch may be tripped, but cannot be closed, as the closing coil is normally out of circuit until the synchronizer is in the position assumed at the synchronous operation of the generators or rotaries, which closes the relay-switch circuit and completes the path of the current through the controller and electrically-operated switches.

Fig. 1 shows the synchronizer with cover removed, as used in the power house of the Pittsburg, McKeesport & Connellsville Railway. It consists essentially of a metal case in which are mounted two solenoids, the upper ends of whose cores are flexibly connected to either end of a lever which is swung centrally on a shaft. Attached to the shaft is a suitable contact arrangement which is normally open. The function of this contact device is to close a circuit through the closing coil of an electrically operated or electro-pneumatic switch. Current to actuate the switch is taken from a source independent of the generators such as that of the exciter. Current to energize the solenoids is derived from the bus-bars and from leads connected to the incoming machine through potential transformers.

A diagrammatic view of the connections of the instrument in a rotary-converter installation is given in Fig. 2. Assume that it is desired to start the rotary converter, which is accomplished by an induction motor not shown in the diagram, and to bring it up to approximate speed ready to connect in circuit. It will be seen that the primary, *b*, of the potential transformer is connected across the bus-bars, and the primary, *a*, of the other transformer is connected to corresponding terminals of the rotary converter behind the electrically-operated switch, that is, between the switch and the rotary. It will be noted from the diagram that the coils of the synchronizer are so connected as alternately to pull their cores down, the left hand coil pulling when the phase difference is 180 degrees, and the

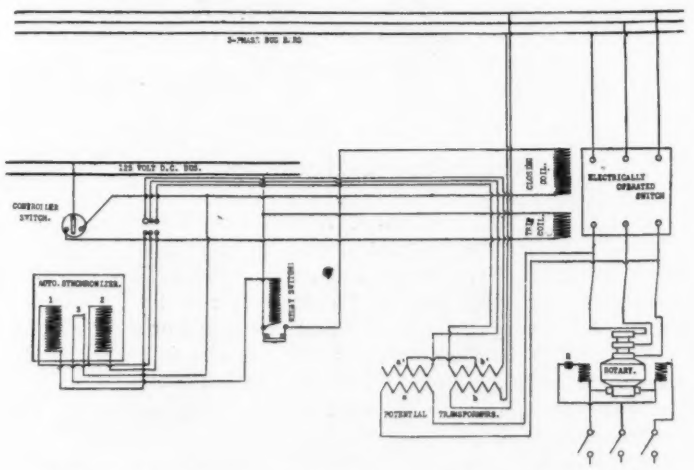



FIG. 2.—DIAGRAM OF AUTOMATIC SYNCHRONIZER WIRING.

right hand coil pulling when the phases of the machines coincide. There is connected to the contacts of the synchronizer a very ingenious device, which withdraws one of the contact brushes when the machines differ too much in speed. As the difference in speed becomes less, this device acts in such a way as to allow the contact to be made in advance of coincidence of phases by an amount corresponding to the time required for the switch to actuate. As the machines differ less in speed, the advance in the contact is correspondingly less. The contacts are never called upon to break any current, and, when properly adjusted, they will last indefinitely. The machines are coupled by this instrument without the least sparking or strain, the ammeters connected to the incoming machines showing hardly any deflection.

For high-voltage work, automatic oil switches are used. The wiring of the various devices forms a complete interlocking system, preventing the coupling of the machines under unfavorable circumstances and avoiding the danger of any damage resulting therefrom. For rotary-converter installations, there has been devised a simple form of electrically-operated switch, which combines the functions of a switch and an automatic circuit breaker, thus eliminating the necessity for the knife switch and fuses.

The demand for a serviceable outdoor type of oil switch adapted for use with alternating-current series arc lighting systems, for cutting out banks of transformers, isolating underground or overhead feeders and mains from main systems and operating inductive loads of all kinds, led the Westinghouse Electric & Manufacturing Company to design and place upon the market a switch to meet all these requirements. It is a double-pole, single-throw switch, mounted in a weatherproof case which may be easily attached to poles or cross arms in the case of overhead systems, or may be hung in manholes where underground systems are used.

The essential features consist of knife-blade contacts submerged in oil and high insulation between poles and between frame and live parts. Knife-blade contacts are used, as they insure the best contact

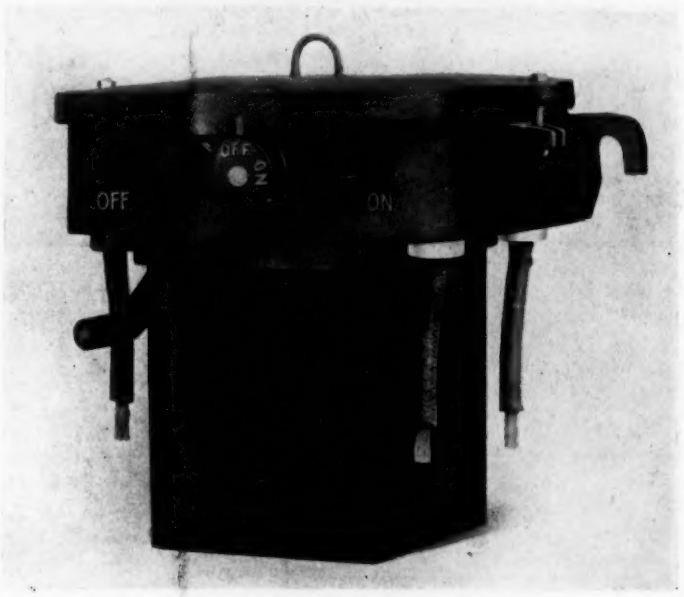


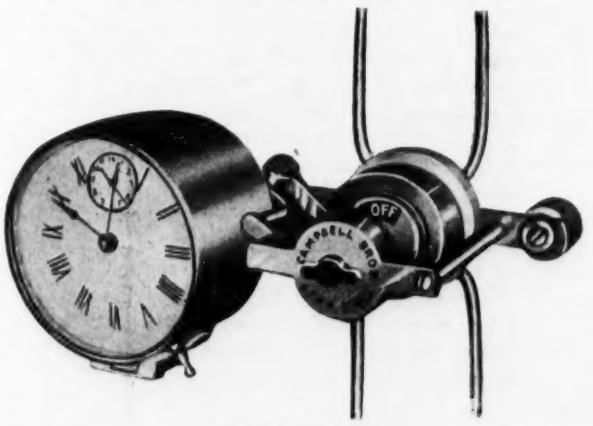

FIG. 3.—OUTDOOR OIL SWITCH.

for low temperature rise. Each jaw has a detachable arcing piece which takes the final break, thus preventing any possibility of arcing between the jaws and blades. These arcing pieces may be removed very easily when worn out or burned away. Suitable barriers are placed between the poles, which prevent the arcs from communicating. The switch is compact and light, weighing but 40 pounds.

There is furnished with this switch a special oil which is especially suitable for use in cold weather, as it has a very much lower congealing point than any oil now on the market which is otherwise suitable for oil switch work. One and one-half gallons are required to fill the tank. The switch has a maximum capacity of 200 amp. at 3,300 volts.

## Time Switch.

The "Campbell" time switch, shown in the accompanying illustration, has recently been placed upon the market by Campbell Bros., of Lynn, Mass. As will be seen, it consists of an indicating enclosed

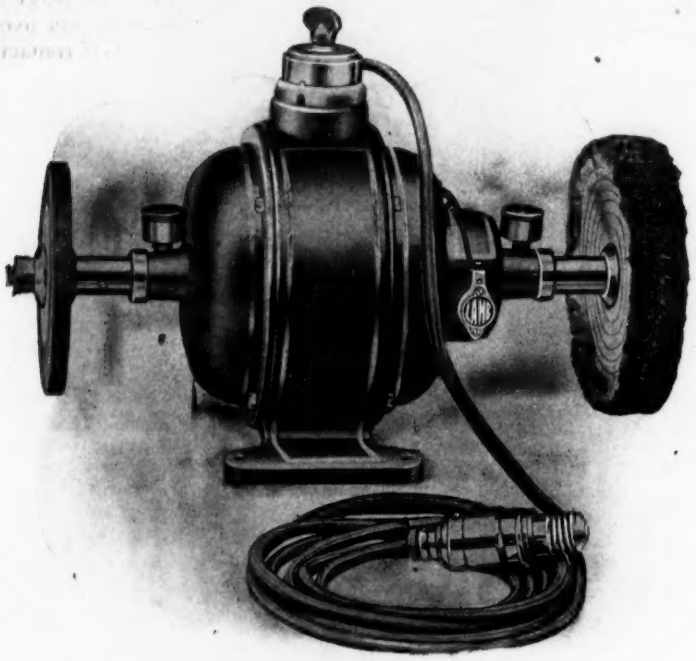



TIME SWITCH.

switch in conjunction with an alarm clock, both of standard type. The switch is actuated by a spring, capable of operating the largest size of switch of the type used. The time attachment is easily set by moving a small thumb piece to the left. The switch may be operated by the rubber handle independently of the automatic features.

## Grinding and Buffing Motors.

To meet the demand for portable electrically-driven grinding machinery, the Lamb Electric Company, Grand Rapids, Mich., is placing on the market a line of grinding and buffing motors ranging from ¼ to 2 hp, the speeds being from 2,200 r.p.m. for the smaller motors to 1,600 for the larger sizes. The armatures are of the



GRINDING AND BUFFING MOTOR.

slotted type, and the field cores of magnetic steel. Easily accessible carbon brushes are used, the bearings are made extra long and the design is such as to give great torque. Smooth running is obtained through the utmost care in balancing. The ¼-hp size is shown in the accompanying illustration.

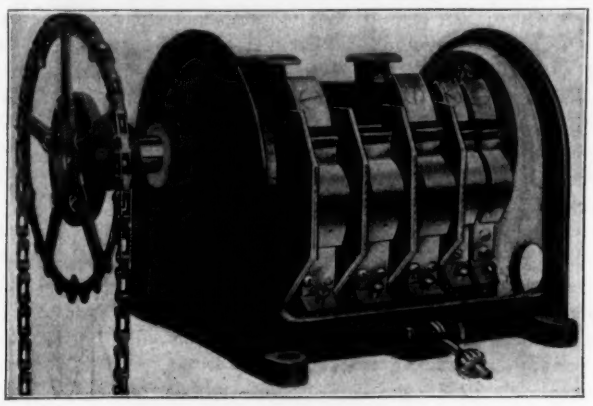
## A New Type of Elevator Switch.

As is well known, there is no service quite so hard on electrical apparatus as that incident to the operation of elevators. A switch which has been brought out to meet the very exacting requirements of this service is shown in the accompanying illustration.

The switch is designed for controlling the main circuit to the motor as well as for changing its armature connections for reversing the direction of motion. It is of the drum type. Experience has shown that no type of switch will stand such severe service as the drum type, as distinguished from the sliding contact type of switch, not only because all of the breaks in the electrical circuit take place in the air and not over a surface, but also because the type permits of the use of pure hard-drawn copper for the movable and stationary contacts in such a manner as to furnish great mechanical and electrical strength with a corresponding minimum amount of deterioration. The cylinder is of cast iron built up in two parts, which are insulated by mica from each other and from the driving shaft. The movable contacts are so punched that they are perfectly interchangeable. Contacts are fastened to the cast-iron cylinder by means of screws so that the contacts may be readily renewed. The stationary contacts or fingers are fastened to stationary brackets in such a manner that they may be readily renewed without disturbing any of the other parts of the controller. As the cylinder is constructed of cast iron and mica, there is no tendency for it to warp or get out of shape, due to moisture or other causes, so that, aside from the renewal of the arc-rupturing contacts, the switch itself is practically indestructible.

There is provided a sheet-iron cover which is drawn down into place by the thumb nuts shown in the illustration, so that when installed all of the operating parts are entirely enclosed and protected from oil and dirt. The switch is provided with a shaft extension having a suitable key-way, so that it may be driven from the operating gear of the elevator in a manner best adapted to a given machine. The switch may be installed in any suitable location, either vertically or horizontally or on its side, without interfering in any manner with its operation.

The switch which is being placed on the market by the Cutler-Hammer Manufacturing Company is designed primarily for use in connection with this company's self-starters, so that ordinarily an elevator equipment, especially for direct-current motors, would consist of one of the above switches and a suitable self-starter for accelerating the motors. For small and medium-sized motors, the switch



ELEVATOR SWITCH.

is plain, as shown in the illustration, but for larger sizes of motors, especially for the higher voltages, the switch is provided with powerful blow-out magnets for taking care of any arcing that may occur. These switches, however, may be built especially for three-phase, alternating-current motors, where the motor is thrown directly across the line in starting. For such cases the self-starter is usually omitted, on account of the inherent characteristics of the usual three-phase induction motor.

## Enclosed Resistance.

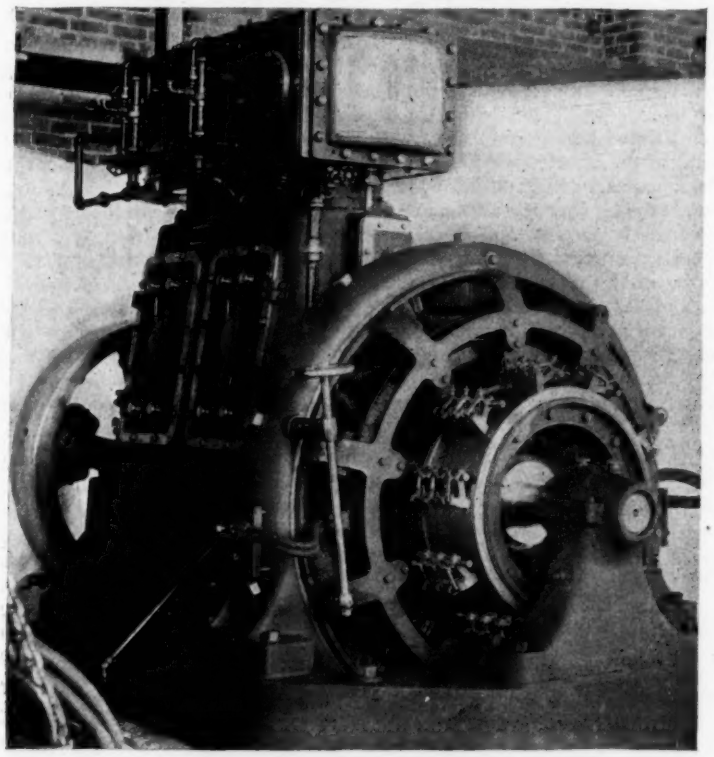
A patent recently issued to H. Ward Leonard covers a new type of enclosed resistance designed to carry large currents. The invention consists, broadly, in using a flat, wide braid, made up of a large number of very small individual strands of round wire, which are braided with a very open mesh, so that the enamel or similar material completely fills in the interstices between the individual strands. Among the advantages of this construction is the elimination of the fire risk. A large single conductor, when fused by excessive current, makes a single arc, the energy of which is so great as to become disruptive, causing an extremely bad fire risk. Molten pellets are generally thrown off from such an arc and the arc will be sustained for a very long time. When, however, the conductor takes the form of the open, flat braid, entirely covered by the enamel coating, and is then fused by excessive current, a large number of different divided arcs results, each of correspondingly smaller energy, and the well-known extinguishing effect due to dividing an arc into a number of smaller ones is taken advantage of. Each little arc is surrounded by a sufficient mass of cooling material and the braided resistive conductor fuses silently and with a practical freedom from all fire risk. Each small strand acts, in fact, like a small enclosed-type fuse. The strain in the enamel, due to suddenly passing a very large current through the braided resistance, is negligible, for each little strand is so flexible and so perfectly reflexed in every direction by the operation of braiding that it is impossible to produce a detrimental strain in the enamel.

The braid is so flat that a very much thinner coating of enamel can be employed than would be the case if a single large round wire were employed, and this results in a much tougher and more perfect job of enameling than had been heretofore possible. The copper connecting wires, or terminal leads, have also been replaced by a round copper braid, composed of a large number of very flexible copper wires, which also has many advantages to the user. The Ward Leonard Electric Company already has this form of resistance on the market, and prefers to employ it wherever the current exceeds about 10 or 15 amp.

## 100-kw Generating Set.

The accompanying illustration shows one of a complete line of direct-connected generating sets now being placed upon the market by the B. F. Sturtevant Company, of Boston. The engine is of the vertical cross-compound type, and is designed to operate at 350 r.p.m. under a steam pressure of 150 lbs. It is equipped with a centrifugal oil thrower placed at the bearing between the engine and generator, and one between the engine and governor wheel. Large detachable hinged oil-tight doors allow of easy access to the crankshafts and connecting rods. A direct-driven pump furnishes oil under a pressure of about 15 lbs. per sq. in. to the various bearings in such a way that no oil reaches the steam spaces. The efficiency of the engine with the forced lubrication is stated to be greater than 90 per cent.

The generator is of the compound-wound type, designed for an output of 100 kw, at which load the temperature rise after a continuous run of 10 hours will not exceed 40 degs. C. in any of the parts. The generator is capable of continuous operation at 25 per cent overload without sparking or undue heating, and it will carry 50 per cent overload for short periods of time without the necessity of shifting the brushes to prevent sparking. The shunt



100-KW GENERATING SET.

and series field coils are separately wound and are so constructed that, although ample insulation is provided, the ventilation is not interfered with. The insulation resistance is stated to be at least one megohm, and although the normal working voltage is only 500, the insulation is subjected to a test for one minute to an alternating e.m.f. of 1,500 volts. As shown in the illustration, the brush holders are staggered on the studs, so that the wear upon the commutator is uniform over the surface. The total weight of the set is 22,000 pounds. The standard machines are built in five sizes, ranging from 17.5 to 100 kw.

## Iowa Convention Notes.

The Iowa Electrical Association Convention, at Dubuque, called out a good attendance of supply men, and a number of companies made exhibits in the Hotel Julien, where the convention was held.

The Johns-Manville Company exhibited Noark fuses at its parlor.

The American Electrical Supply Company, represented by F. D. Phillips, kept open house at one of the parlors.

The Electric Appliance Company made an exhibit of Sangamo meters and other specialties. P. R. Boole was in attendance.

The W. R. Garton Company had a parlor full of railway supplies and high-tension insulators and pins. President W. R. Garton and E. D. Hill were in attendance.

Porter & Berg, of Chicago, made the largest exhibit at the convention, showing the numerous electric railway specialties for which they are agents. E. R. Mason was in charge.

The Nernst Lamp Company, which, judging from statements made on the floor of the convention, is doing an increasing business in the State, exhibited its lamps around the lobby galleries. It was represented by T. M. Crane.

The Wagner Electric Manufacturing Company exhibited one of its single-phase motors and gave out information about the new elevator motor which makes operation of elevators as feasible off of single-phase, alternating-current circuits as off of direct-current circuits. S. Sparrow presented a paper before the convention on this motor and its performances. C. E. Delafield and E. K. Leyman were also present.

The Duncan Electric Manufacturing Company, represented by William H. Sinks, had many up-to-date features to show in the Duncan meter. These features include the usual bearing, the threadless jewel post, the hollow nickel-steel spindle, the very light revolving element, high torque, dust-proof cover and fire-proof binding posts. The output of Duncan meters is now stated to be 100 per day, the company recently having trebled its facilities.

The Westinghouse Electric & Manufacturing Company exhibited in its rooms a type of instrument it has just completed for the market. This is a combination alternating-current voltmeter and wattmeter, which works on a principle not heretofore employed in portable instruments, giving close readings over a long range. A hand is moved around a large scale until, when the proper value of power is indicated, the pointer of the instrument balances at the center of its range. It is intended especially for facilitating lamp testing. Clarence A. Ross, H. A. Coughlan, A. M. Miller and W. R. Pinckard were in attendance.

The National Electric Company, of Milwaukee, manufacturer of the Christensen air brake and electrical machinery, was well represented. The new universal Lundell motor was shown. The design is a departure from standard practice, as the entire magnetic circuit, including the yoke, is laminated. This type of motor also embodies other features of advantage and improvement. The walls were hung with bromide enlargements conveying a good idea of the line of apparatus manufactured by this company. The *National Electrical Catechism,* a new publication dealing with the fundamental elements of electricity, was distributed, the company inviting names on its mailing lists to receive free of charge all future issues. Catalogues, mailing cards and other literature were also distributed, including the National souvenir watch fob, bearing as a charm a bas-relief representation of the company's trademark. The company furnished the orchestra which so pleasurably entertained the convention attendants at the hotel on Thursday evening. Representing the company were Ashley P. Peck, electrical sales agent; J. Frank Perry, sales engineer; H. M. Klingenfeld, advertising manager, and H. M. Voigt.

Other companies were represented as follows: Columbia Incandescent Lamp Company, John G. Boyd. Fort Wayne Electric Works, Walter Goll, F. S. Weinmeyer; Electric Appliance Company, J. K. Alline; Viscosity Oil Company, E. R. Stubbs; Standard Electrical Manufacturing Company, John Rice, R. W. Loose; General Electric Company, W. H. Colman, F. W. Taylor, G. A. Seabring; Raymond Lead Company, J. B. Hermann; A. Sorge, Jr., & Co., E. Emory; *Western Electrician,* W. E. Keily, J. D. Downer and F. L. Perry; Allis-Chalmers Company, F. G. Whipple; National Battery Company, E. L. Draffen; Central Electric Company, H. M. Coulter; Crouse-Hinds Company, F. F. Skeel; Electric Storage Battery Company, John A. White; Adams-Bagnall Electric Company, J. G. Pomeroy; H. W. Johns-Manville Company, Frank E. Johnson; Warren Webster Company, E. A. Evers; *Illustrated Electricity,* I. A. Bennett; Fairbanks-Morse Company, H. H. Clarke; Taylor Electric Truck Company, C. H. Dodge; Westinghouse Traction Brake Company, C. J. Olmstead; *Street Railway Review,* Daniel Royse; Gould Storage Battery Company, P. B. Yates; General Incandescent Arc Light Company, Francis Raymond, A. A. Morton; Lord Electric Company, E. M. Hamlin; National Carbon Company, C. W. Wilkins; Illinois Electric Company, O. T. Kimmel; Sterling Meaker Company, F. D. Willis; National Lead Co., J. B. Mendenhall.

# Industrial and Commercial News

## *Commercial Intelligence.*

THE WEEK IN TRADE.—Reports of trade showed some irregularity as a result of the erratic weather, but on the whole business was satisfactory. Much business for fall delivery is already noted, and more supplementary spring and summer contracts are being placed than jobbers anticipated. Mercantile payments are also increasingly prompt. Industrial activity expands, iron furnaces and steel mills maintaining their good record, textile plants securing larger orders, and footwear manufacturers are able to hold full prices without curtailing operations. Labor controversies are few and cause little inconvenience, while immigration for the last week was more than double that of the corresponding week in 1904. Transporting interests are able to handle the increased business with little congestion, railway earnings thus far reported for April exceeding last year's by 10.2 per cent. The iron and steel industry is in splendid condition, contracts covering deliveries well into next year in many departments, and there is no division that can be styled dull. Probably the best reports still emanate from makers of railway equipment—notably rolling stock and rails. Detailed trade reports from some cities, while showing a shrinkage from some weeks ago, all point to heavy increases over the same period of preceding years. Chicago reports wholesale business beyond expectations and reorders satisfactory. Kansas City reports a heavy business in farm implements; St. Louis a falling off in wholesale trade, but a good Easter business at retail. In the Northwest, retail trade has increased in both the city and country, while jobbing trade has naturally slackened. Exceptions to this are noted in Duluth, where strikes in the iron range country interfere with business, and at Sioux Falls and Sioux City, where the weather has been too cold for retail trade. Along the lakes, Milwaukee and Detroit report retail business backward because of unseasonable weather. Damaging frosts visited the South. The peach crop of northern Georgia has been injured, but the crop in the central and southern parts of the State seems to have escaped. Heavy rains and cold weather have delayed cotton planting in Texas and in the Memphis district. The business failures during the week ending April 20, as reported by *Bradstreet's*, numbered 183, as against 196 the week previous, and 199 the corresponding week last year. Business was very quiet in the copper market and buying continues to be of the hand-to-mouth character. The closing quotations are: Lake, 15¼ to 15⅜c.; electrolytic, 15⅛ to 15¼c.; casting stock, 14⅞ to 15c.

ALLIS-CHALMERS SALES.—The Cambria Steel Company has recently purchased for its new power house two 800-kw. Bullock generators. These will be built by the Allis-Chalmers Company at its electrical works in Cincinnati, and are intended to furnish power for large ore handling cranes. The Obion Lighting Company, of Obion, Tenn., has ordered from the Allis-Chalmers Company one Reliance engine with cylinder 40 x 24 in., 175-kw two-phase, Bullock alternator with 4-kw exciter, together with switchboard, boiler, duplex feed water pump, arc lamps and regulator, etc., to furnish the complete equipment for an electric lighting plant. The generator will be connected to the engine by a belt and the exciter will be separately driven. The American Cereal Company, which is reconstructing its plant at Cedar Rapids, Ia., has contracted with the Allis-Chalmers Company, of Milwaukee, to furnish the electrical power equipment, including one 800-kw, 60-cycle, three-phase, alternating current Bullock generator, and one 30-kw Bullock, belted exciter. The engine which it had in use before the fire has been shipped to Milwaukee and will be rebuilt by the Allis-Chalmers Company, for direct connection to the new generator. Bernard F. Weber, of Chicago, Ill., has ordered from the Allis-Chalmers Company two heavy duty Reynolds Corliss engines, having cylinders 26 x 48 in. These engines are to be non-condensing and will run at 90 r.p.m. with 125 lbs. steam pressure. They will be connected by belt for driving brick machinery. The stroke and exhaust valves are to be operated by independent eccentrics, so arranged that both can be disconnected and operated by hand with one starting bar, and so constructed that it will be impossible for the interlocking device to be engaged at the wrong time and cause an accident or breakdown. Walter Baker & Company, of Milton, Mass., who will erect a new power house at their factory in Dorchester, Mass., have ordered from the Allis-Chalmers Company the complete machinery equipment, which includes two 750-kw Bullock alternating current generators, for direct-connection to Reynolds Corliss vertical cross-compound engines, and two 125-kw Bullock generators with exciters. The cylinders of the engines will be 22 and 48 inches in diameter and they will have a 48-inch stroke. The two large generators are designed to operate at 120 revolutions and the smaller at 277 r.p.m. The electrical apparatus is to be built at Cincinnati, and the engines will be furnished from the West Allis, Milwaukee, plant of the Allis-Chalmers Company.

WESTINGHOUSE-GENERAL ELECTRIC RELATIONS.—Rumors have continued to circulate in financial and trade circles to the effect that the Westinghouse and General Electric companies are engaged in a trade war, and that the patent agreement between the two companies has been broken. It is well known that the Westinghouse and General Electric companies have exchanged patent licenses, and, under the agreement covering such exchange, each company can freely use the inventions covered by patents of the other; but in other respects the two companies are active business competitors. The patent agreement was made in March, 1896, and is effective for fifteen years. In making use of the patent rights under the license, each company has, however, relied upon its own experience in manufacturing and, on the whole, has designed and promoted its own apparatus, rather than making a close copy of the other company's apparatus. It is said that the patent agreement has resulted in a total saving of about $1,000,000 yearly, which previously was spent in patent litigation, besides various other items of time and expense. The expiration of the Tesla patents next month has stimulated competition among electrical manufacturers in the building of the induction type of motor. As a result of this, the two large companies have each brought out a new type of induction motor, embodying changes and improvements in the motor covered by the old Tesla patents, and which will be placed on the market at a material reduction in price. Several other electrical manufacturers are now in the market for induction motor orders, and are prepared to make shipments. The expiration of the Tesla patents and the attention given this important epoch in the electrical industry by the concerns engaged in the manufacture of electrical apparatus has probably been at the bottom of the rumors to the effect that the working agreement said to exist between the two largest electrical manufacturers as to business harmony is about to be terminated.

SAN JOAQUIN POWER COMPANY.—R. B. Elder, manager of the Wagner-Bullock Electric Company, of San Francisco, secured the contract for furnishing two Allis-Chalmers 1,000-kw three-phase, 550-volt generators for the San Joaquin Power Company's new power transmission plant in the San Joaquin Valley. D. H. Scribner, the new coast manager of the Allis-Chalmers Company, obtained the contract for the two turbine water wheels to which the generators will be direct-connected. Seven 350-kw transformers will raise the line voltage to 19,200 volts for transmission to the sub-station, where four 500-kw lowering transformers are to be installed. These will be supplied by the Allis-Chalmers Company. Quick deliveries are to be made at Pollasky, Fresno County.

BIDS FOR LIGHT FIXTURES.—Bids will be received at the Treasury Department, Washington, D. C., until May 2, for furnishing and placing in position certain combination gas and electric light fixtures in the U. S. Courthouse and Post Office at Athens, Ga. Bids will be received May 3 at the Treasury Department, Washington, D. C., for manufacturing and placing in position in complete working order in the U. S. Post Office at Anniston, Ala., certain combination gas and electric light fixtures. Address H. A. Taylor, Assistant Secretary.

BIDS WANTED.—Bids will be received until May 15 by the Belknap Hardware & Manufacturing Company, Louisville, Ky., for installing an electric light, heat and power plant, including two 75-kw generators, direct connected; one 30-kw generator, direct connected; two 110-hp compound engines; one 45-hp simple engine; two 150-hp water-tube boilers; two 150-hp boiler-feed pumps; one 200-hp feed-water heater; one switchboard and instruments, necessary breaking, piping, tubing, ventilating apparatus, pneumatic tube system, including blowers, etc.

GENERAL ELECTRIC AND AMERICAN LOCOMOTIVE.—There are no new developments in the matter of the rumored combination of the General Electric Company and the American Locomotive Company. A combination of these two interests is regarded in some quarters as inevitable, based on the belief that the building of electric locomotives will form one of the most important industries of the future. No official information on the subject is obtainable.

GOVERNMENT BIDS.—Bids will be received May 2 at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the Navy Yard, Norfolk, Va., a quantity of supplies, including electrical supplies, wire, steam pumps, etc. H. T. B. Harris, Paymaster General, U. S. N. Bids will be received May 2 by Brigadier-General A. W. Greely, Chief Signal Officer U. S. A., for furnishing the Signal Corps 500 McIntyre sleeves for No. 12 wire; 1,000 paper sleeves, 18x3; 5,000 ft. each of 15 and 20-pair, 2,000 ft. 30-pair, 1,000 ft. 40 pair and 12,000 ft. 10-pair paper insulated aerial cable, etc. Also on May 3 for furnishing 500 poles with foot supports; 500 iron cross arms and 100 attachments to iron poles for wooden cross arms. Bids will also be received May 23 by the Bureau Supplies and Accounts, Navy Department, for furnishing at the Navy Yards, Mare Island, Cal., and Puget Sound, Washington, a quantity of naval supplies, including motor, incandescent lamps, battery cells, spare parts for Loring switch pipe and fittings, machinery, etc. H. T. B. Harris, Paymaster-General, U. S. N.

THE CUYAHOGA CONSTRUCTION COMPANY, of Cleveland, Ohio, has recently contracted with Allis-Chalmers Company, of Milwaukee, for the equipment of three sub-stations of the Sandusky, Norwalk & Mansfield Railway, the headquarters of which are located at Norwalk, Ohio. Each of these stations will be equipped with one 300-kw compound-wound Bullock rotary converter, three 110-kw static transformers and complete switchboard apparatus, including lightning arresters. Five car equipments, each consisting of four Bullock 50-hp railway motors, with controllers, etc., have also been ordered. This road is to extend from Plymouth to Norwalk, Ohio, where passengers can be transferred to the electric railway extending to Sandusky and there make connections with the Lake Shore Electric Railway for both Toledo and Cleveland. Eventually there will be uninterrupted service between Mansfield and Toledo.

THE BUFFALO POLE LINE CONSTRUCTION COMPANY, which was recently incorporated with a capital of $10,000, for the purpose of continuing the general electric business formerly carried on by Johnson & Saunders, of Buffalo, N. Y., will, as the name implies, specialize in any kind of pole line work, telephone, telegraph, electric light, power transmission or trolley; also power plants, switching stations, transformer stations, electric railroad-track, roadbed and equipment in addition to the overhead work. It will also install any of the apparatus, etc., which make up a complete outfit for the transmission or consumption of electrical energy. The officers are C. S. Saunders, president; Wm. E. Robertson, vice-president, and R. D. Johnson, secretary and treasurer, all of Buffalo, N. Y. The main offices of the company will be located at 651 Ellicott Square, Buffalo, N. Y.

THE INTERNATIONAL TELEPHONE MANUFACTURING COMPANY, of Chicago, recently secured a contract to manufacture apparatus for the enlargement of the police signalling and telephone system of St. Paul, Minn. The order was secured through the Municipal Signal Company, of Chicago, whose system is in use in that and many other large cities, and which is said to be one of the most practical systems ever designed for modern police department service.

CARNEGIE TECHNICAL SCHOOLS.—Contracts for the gas engines and electric generators for the light and power plant of the Carnegie Technical schools at Pittsburg, are stated to have been awarded to the Westinghouse Electric & Manufacturing Company for about $33,000.

TELEPHONE BIDS.—Bids will be received at the office of the Engineer, U. S. Reclamation Service, at Boise, Idaho, June 15, for the construction of a pole line and telephone system about 18 miles in length, in connection with the Minidoka project, near Minidoka, Idaho.

BIDS FOR WATTMETERS.—Bids will be received May 10 by Capt. Wm. Weigel, constructing quartermaster, U. S. A., for furnishing and installing electric light fixtures and wattmeters in 14 buildings at Fort Sheridan, Ill.

## *Financial Intelligence.*

THE WEEK IN WALL STREET.—Uncertain conditions prevailed in the speculative market, the irregularity in prices being of an extreme character. In spite of the strength shown by a few of the leading securities early in the week, the list, on the whole, was irregular and the general market became weak as the week advanced. The fact that the recent exaggerated demand for iron and steel has eased off was not taken into particular account, and the United States Steel stocks, which were very strong at first and which made new high records on Wednesday, seemed to show in their later weakness merely sympathy with the rest of the list. In fact, at the beginning of the week, industrials generally showed very strong tendencies, and favorable developments, such as reports of new and exceedingly large orders for railway equipment, had a tendency to augment the active speculative interest which is taken in such properties. Electric and traction stocks were decidedly weak, in common with the rest of the list, and closed with losses in all cases, with one exception. Allis-Chalmers common is off ½-point, closing at 16⅛, and preferred 1 point, the last quotation being 60¼. General Electric kept unchanged at 180 throughout the week, this being the closing price and a loss of 4⅛ points. Westinghouse common closed at 174, a loss of 3 points, but the preferred is credited with a net gain of ¾-point, closing at 193. Among the tractions the closing quotations are as follows: Brooklyn Rapid Transit, 66 (a net loss of 4⅛); Metropolitan Street Railway, 120 (net loss 2⅝), Interborough Rapid Transit, 206 (net loss 3½), and Philadelphia Rapid Transit, 128 (net loss 2). Western Union Telegraph closed at 93½, and American Telephone & Telegraph at 144½, being a net loss of ½ point in each case. Electric Storage Battery lost 3 points, closing at 83. The curb market was featureless. Following are the closing quotations of April 24:

NEW YORK

| | Apr. 18 | Apr. 25 | | Apr. 18 | Apr. 25 |
|---|---|---|---|---|---|
| Allis-Chalmers Co. | 16 | 15⅛ | Electric Vehicle pfd. | 21 | 18 |
| Allis-Chalmers Co. pfd. | 60⅜ | 58 | General Electric | 183 | 178 |
| American Tel. & Cable | 91 | 91 | Hudson River Tel. | .. | .. |
| American Tel. & Tel. | 144½ | 143 | Interborough Rap. Tran. | 206 | 205 |
| American Dist. Tel. | 32 | 32⅛ | Metropolitan St. Ry. | 121⅛ | 119 |
| Brooklyn Rapid Transit | 68¼ | 66⅜ | N. Y. & N. J. Tel. | .. | .. |
| Commercial Cable | .. | .. | Marconi Tel. | .. | .. |
| Electric Boat | 34 | 35 | Western Union Tel. | 93⅝ | 93¾ |
| Electric Boat pfd. | 75 | 75 | Westinghouse com. | 175 | 172½ |
| Electric Lead Reduction | .. | .. | Westinghouse pfd. | 193 | 190 |
| Electric Vehicle | 12 | 12 | | | |

BOSTON

| | Apr. 18 | Apr. 25 | | Apr. 18 | Apr. 25 |
|---|---|---|---|---|---|
| American Tel. & Tel. | 144½ | 144 | Western Tel. & Tel. pfd. | *101 | 99½ |
| Cumberland Telephone | 120 | 119¼ | Mexican Telephone | 1⅛ | 1⅛ |
| Edison Elec. Illum. | *255½ | *255 | New England Telephone | 139¼ | 139½ |
| General Electric | 183 | 177½ | Mass. Elec. Ry. | 20¼ | 19¾ |
| Western Tel. & Tel. | 18¼ | *20 | Mass. Elec. Ry. pfd. | *68 | 67½ |

PHILADELPHIA

| | Apr. 18 | Apr. 25 | | Apr. 18 | Apr. 25 |
|---|---|---|---|---|---|
| American Railways | 54 | 53⅛ | Phila. Traction | 99⅞ | .. |
| Elec. Storage Battery | 84 | 82½ | Phila. Electric | 11⅛ | 11⅛ |
| Elec. Storage Battery pfd. | .. | .. | Phila. Rapid Trans. | 35⅜ | 33⅞ |
| Elec. Co. of America | 12¼ | 12 | | | |

CHICAGO

| | Apr. 11 | Apr. 25 | | Apr. 18 | Apr. 25 |
|---|---|---|---|---|---|
| Central Union Tel. | .. | .. | National Carbon pfd. | 116 | 114 |
| Chicago Edison | 167 | .. | Metropolitan Elev. com. | 22½ | 21 |
| Chicago City Ry. | .. | .. | Union Traction | 7 | .. |
| Chicago Tel. Co. | .. | .. | Union Traction pfd. | 30 | .. |
| National Carbon | 66 | *65⅛ | | | |

* Asked.

TELEPHONE MORTGAGE.—The Independent Telephone Securities Company, of Utica, N. Y., has filed a mortgage for $15,000,000 in favor of the Security Trust Company of Rochester to secure the issue of a series of 33-year 5 per cent collateral trust gold bonds. The Independent Securities Company is a holding corporation organized several months ago to acquire control of various telephone plants. Up to date it has secured control of a number in the vicinity of Utica, among them the Home Telephone Company of Utica, the Black River Telephone Company of Lowville, the County Telephone Company of Herkimer, the Otsego Home Telephone Company of Cooperstown and the Clinton Home Telephone Company.

DIVIDENDS.—The Cambridge Electric Light Company has declared a regular quarterly dividend of 2 per cent., payable May 1. The directors of the Automatic Electric Company have declared the regular quarterly dividend of 2 per cent., payable May 1. National Carbon directors have declared the regular quarterly dividend of 1¾ per cent. on the preferred stock, payable May 16. The Houghton County Electric Light Company has declared a semi-annual dividend of 3 per cent. for the preferred stock, payable May 1. The Michigan State Telephone Company has declared a dividend of 1½ per cent. quarterly on the $2,285,000 preferred stock.

CANADIAN GENERAL ELECTRIC.—The shareholders of the Canadian General Electric Company have decided to increase the capital stock from $3,000,000 to $5,000,000, by the issue of 20,000 shares of common stock. Only 9,000 shares will be issued at present and this will be offered to shareholders at $125, the proceeds to be used to wipe off an overdraft at the bank and for necessary extensions.

MARCONI WIRELESS.—At the annual meeting in Jersey City of the stockholders of the Marconi Wireless Telegraph Company of America, held April 17, the following directors were elected for five years each: Eugene H. Lewis, John Bottomley and Alfred B. Trigge.

THE HUDSON RIVER POWER COMPANY, of Queensbury, Warren County, which operates the electrical power plant at Spier Falls, in the Adirondacks, has filed with the Secretary of State a certificate of increase of capital from $1,000,000 to $10,000,000.

NEW ENGLAND TELEPHONE.—The annual meeting of the stockholders of the New England Telephone & Telegraph Company will be held May 1.

GENERAL ELECTRIC ANNUAL MEETING.—The annual meeting of the General Electric Company will be held in Schenectady, N. Y., May 9.

# General News of the Week

## *The Telephone.*

BAKERSFIELD, CAL.—W. E. Blaisdell and Fred C. Clark have been granted a franchise to operate a telephone line in the county.

ALHAMBRA, CAL.—P. T. Spencer has applied to the Board of Trustees for a telephone franchise here. He was the successful bidder for the franchise.

VACAVILLE, CAL.—The Mutual Telephone Company has permanently organized and O. H. Allison was elected president; T. J. Mize, secretary, and G. W. Crystal, treasurer.

RED BLUFF, CAL.—Sealed proposals will be received by the undersigned until 10 a. m., May 6, for the telephone franchise as applied for by L. L. McCoy, of Red Bluff. W. A. Fish is clerk.

MONROVIA, CAL.—The Postal Telegraph Company has recently secured the right to use the poles of the Pacific Electric Railroad Company, and also to open telegraph offices in all Pacific electric depots.

BEAR VALLEY, CAL.—Citizens of Bear Valley have organized a mutual telephone company, with O. I. Butterfield, president, and A. T. Hain, secretary. The line will extend from Willow Creek to San Benito via Bear Valley.

DOWNEY, CAL.—The Downey Home Telephone & Telegraph Company has been incorporated with a capital stock of $50,000. The directors are P. T. Spencer, L. K. Parks and Charles E. Stanton, of Los Angeles, and Arthur L. Darby and M. Miller, of Downey.

SANTA BARBARA, CAL.—The Supervisors at Santa Barbara have granted a franchise to the Home Telephone Company for a telephone line through the northern part of the county. This is intended as a part of a franchise which, when it is all complete, will allow the Home Company to extend a long-distance line to San Francisco.

REDDING, CAL.—The farmers of the Oak Run section in conjunction with the directors of the People's telephone line in Fall River and Burney Valley will extend the telephone line from Redding to Montgomery Creek, where it at present joins the Buick-Wengler line. The proposed line will run from Montgomery Creek down to Oak Run to Millville and then go to Redding by way of Palo Cedro. Bella Vista may also be included.

VISALIA, CAL.—The Sunset Company is making extensive improvements in its Visalia system. It will soon begin the work of installing over 600 common battery telephones. Under the new arrangements, there will be individual, four-party line, and ten-party line service. All previous ten-party lines within a radius of half a mile, and for which $1.25 has been charged, have been abolished, and in place thereof four-party lines will be installed, with a rate of $1.50 per month.

RICHLAND, ILL.—The Richland & Shelbyville Township Mutual Telephone Company has been incorporated with a capital of $2500. The incorporators are L. N. Douthit, James Stewardson and others.

MARKLEVILLE, IND.—The Markleville Telephone Company has been incorporated with a capital of $10,000. Incorporators are Jas. Stickler, Robert Collier and others.

TOPEKA, IND.—The People's Mutual Telephone Association, capital stock $2000, has been incorporated. Charles F. Mossenan, Charles Mann, G. E. Miller and J. H. Barr are directors.

MILTON, IND.—The Co-operative Telephone Company has been organized by the citizens of this community and will install a telephone plant. Wilbur Dodridge is president and L. W. Besson, secretary.

ANDERSON, IND.—Judge Greenlee, of the Superior Court of this county, while passing on claims, held that a telephone was a requisite in business life, and alowed the bill to which creditors had objected.

BRINGHURST, IND.—The Bringhurst Co-operative Telephone Company has filed articles of incorporation with a capital stock of $4970. Albert B. Cohn, R. Q. Tidrick, C. M. Smock and Henry Carter are directors.

BERNE, IND.—The Union Telephone Company, of Adams County, has filed articles of incorporation with the Secretary of State. The capital stock is $3,000. J. D. Mason, R. B. Kerr, Samuel Tetler and F. Hisey are directors.

TELL CITY, IND.—The City Council has granted a franchise to the Eckerty-Branchville & Cannellon Telephone Company to enter the city. Heretofore the Cumberland Telephone Company enjoyed a monopoly of the business.

MT. STERLING, IND.—The Vevay, Mt. Sterling & Sugar Branch Telephone Company has filed articles of incorporation with the Secretary of State. The capital stock is $2500. Ben N. Davis, J. B. Ramseyer and W. O. Marble are directors.

SOUTH BEND, IND.—The stockholders of the South Bend Home Telephone Company held their annual meeting April 20. The company has prospered during the year, a dividend of 1 per cent. semi-annually being declared. The company has nearly $500,000 invested and has nearly 4,000 telephones connected up. Officers were elected as follows: President, Theodore Thorward; vice-president, E. F. Yarnelle; secretary, Elmer Stone.

HATFIELD, I. T.—Citizens at Hatfield and Smithville, I. T., have organized a company for the purpose of building a telephone line between the two towns.

CLARENCE, IA.—The Clarence Telephohne Company is making preparations to build a new office and central station in this city.

BUFFALO CENTER, IA.—The Buffalo Township Telephone Company of this city has been formed; capital $6000, by O. B. Russ and others.

WATERLOO, IA.—The United States Telephone Company is preparing to rebuild and remodel its plant at a cost of $400,000.

MOULTON, IA.—The Farmers' Mutual Telephone system of this city has been formed; capital $1000. S. H. Jordan and others are the incorporators.

SPENCER, IA.—The material has been ordered to extend the Mincer telephone line to Royal. This line will connect with several other independent farmers' lines that have been organized. There is also a movement on foot to run a through wire from Royal to Spencer to handle the farmers' business between these two places. A farmers' toll line from this place to Fostoria by way of Langdon will also be built soon, the material having been ordered. This will connect up with a farmers' line at Langdon and two or three other rural lines at Fostoria.

KANSAS CITY, KAN.—The Home Company, of Kansas City, has purchased the local system at Independence and will run two copper wires direct from Kansas City to Caney, Kan.

BALTIMORE, MD.—The Maryland Telephone Company announces a day rate of 60 cents and a night rate of 30 cents for five-minute service over its newly opened line to Cumberland, instead of the usual three-minute service, ordinarily charged for over long-distance lines.

BALTIMORE, MD.—A fine building will be erected by the American Telephone & Telegraph Company, of New York, which is the parent company of the Chesapeake and Potomac Telephone Company, of this city. It is said that the structure, together with the ground, will represent an investment of $160,000.

ELKTON, MD.—The Diamond State Telephone Company has begun the erection of a line between Elkton and Cowenton. The company has lines running to almost every town and village in the county and has about 500 subscribers. Recently the line has been rebuilt between Elkton and Rising Sun and Cherry Hill and Elkton.

FALL RIVER, MASS.—The annual meeting of the stockholders of the Fall River Automatic Telephone Company has been held and the following officers were elected: President, Edward B. Jennings; treasurer, Bradford D. Davol. Directors: the foregoing, with Edmund W. Wakely, of Englewood, N. J.; John T. Swift, Philip A. Matthewson, Joseph Watters, Martin Feeney. The financial statement is as follows: Assets—Insurance, $95.54; construction, $75,583.74; toll line, $3756.65; teams, $280; interest, $216.20; real estate and buildings, $10,893; taxes, $471.55; license, $33,750; accounts and cash $4439.27; total, $229,485.95. Liabilities—Capital, $135,000; depreciation, $6943.92; profit and loss, $16,442.77; accounts payable, $5099.26; funded debt, $7500; bills payable, $58,500; total, $229,485.95.

HEMLOCK, MICH.—Another rural telephone line is projected by the Union Telephone Company, beginning two and a half miles north of here, thence straight south to the State road, thence to Hemlock.

HART, MICH.—The Farmers' Mutual Telephone Company has been organized to furnish telephone service in Oceana County at cost. The officers of the new company are: President, C. W. Taylor; secretary and treasurer, Roger Southwick. Directors: Lucius Slocum and Kim Croff.

DETROIT, MICH.—At the annual meeting of the stockholders of the Michigan Telephone Company the following directors were re-elected: N. W. Harris, W. C. McMillan, Isaac Sprague, Frederick A. Farrar, A. W. Harris, W. A. Jackson, Frank J. Hecker, Dudley E. Waters, William Judson, John T. Shaw, Henry Russell, A. E. F. White, Ellwood T. Hance, Allen B. Forbes, T. H. Newberry. The directors, at a meeting later on, re-elected the following officers: N. W. Harris, chairman of the board of directors; William A. Jackson, president; Truman H. Newberry and Isaac Sprague, vice-presidents; W. I. Mizner, secretary; Chester Corey, assistant secretary; John T. Shaw, treasurer, and W. L. Burrows, assistant treasurer. During the eleven months ending December 31, 1904, this company expended for construction in connection with the improvement and extension of its exchange and toll line plants and betterments in facilities, to accommodate the large growth of business and afford better service to the business already in hand, the sum of $1,017,724.96. The increase in subscribers is 10,736, and the total as of December 31, connected to exchanges operated directly by the company was 66,342. To this number should be added approximately 11,000 sub-licenses and other affiliated interests, making a total of 77,342 stations connected to the service. The funds provided through the reorganization and by the subsequent issue of $725,000 of bonds, together with the net earnings, have been sufficient to care for all of the expenditures and for the payment of all the floating indebtedness of December 31, 1904.

BRADFORD, MINN.—The Farmers' Telephone Company, of Bradford, has been organized.

WADENA, MINN.—The Minnesota Central Telephone Company will build the toll line between here and Long Prairie.

VIRGINIA, MINN.—The Mesaba Telephone Company will make a number of improvements in this city during the summer.

MADELIA, MINN.—The Armstrong Telephone Company, of Lewisville, is to extend its line to this city this spring.

NEW ULM, MINN.—The New Ulm Rural Telephone Company will expend $50,000 in building rural lines in Brown and Nicollet counties.

HOKAH, MINN.—The Electric Telephone Company is a new farmers' line built into Hokah. John Bickel is president of the company.

ST. PAUL, MINN.—The Senate has killed Senator Peterson's bill allowing cities and villages to construct and operate telephone lines.

MANKATO, MINN.—The Tri-State Telephone Company will build a new line from this city to points in the western portion of the state.

CROOKSTON, MINN.—The Polk County Telephone Company with a capital of $50,000 has been incorporated by F. M. Slyterm and C. D. A. Carter.

BENSON, MINN.—The Swift County Telephone Company, with a capital of $25,000 has been incorporated by L. W. Stone and Leslie Matthews.

MONEY CREEK, MINN.—At a meeting held by the farmers around this city it was decided to build a farmers' telephone line from the upper end of the Campbell Valley down to this city. John Fitting is president.

WATKINS, MINN.—The Watkins Telephone Company has been formed, capital stock, $10,000. Incorporators: H. J. Wartman, J. P. Olson, H. J. Kainer and C. C. Vitrance, all of Watkins.

MINNEAPOLIS, MINN.—The Twin City Telephone Company will erect a toll station at Merriam Park, to cost $30,000. The company will build 1,000 miles of additional long-distance lines this summer.

MONTROSE, MISS.—Two stock companies are being organized to build, among other things, an independent telephone system from Newton to Bay Springs, taking in Garlandville, Baxter, Montrose and Louin.

HAVRE, MONT.—The Milk River Telephone Company has been formed with $50,000 capital, to build toll lines, including one to Glasgow.

MAXVILLE, MO.—The Maxville Telephone Company, of this city, has been incorporated with a capital of $1000.

KANSAS CITY, MO.—The Home Telephone Construction Company, subsidiary to the Home Telephone Company, has been incorporated; capital, $30,000.

BEATRICE, NEB.—A number of men of this city have purchased the Hebron Home Telephone plant. G. H. Johnson is president.

HUMBOLDT, NEB.—The Richardson County Telephone Company has purchased the Verdon Mutual concern, stock and equipment, with a view to consolidating.

TRENTON, N. J.—Edwin R. Walker, of this city, has been appointed by Vice-Chancellor Bergen receiver for the State Telephone Company.

OSWEGO, N. Y.—A franchise has been granted to the New Amsterdam Telephone Company.

ALBANY, N. Y.—The Clifton Park Telephone Company (Saratoga County) has filed a certificate with the Secretary of State, showing that its capital has been increased from $5000 to $10,000.

DANSVILLE, N. Y.—The Livingston County Telephone Company has been incorporated with a capital stock of $200,000. The directors are William Kramer, J. H. Jackson and Frank Fielder, of Dansville.

GLOVERSVILLE, N. Y.—Gloversville is to have a new independent telephone company. It is the intention of the new company to form an organization with $200,000 capitalization and install a modern plant for the cities of Johnstown and Gloversville. LeRoy W. Stanton, an electrical telephone engineer of Cleveland, Ohio, is in the city promoting the project.

ELIZABETHTOWN, N. Y.—The Lewis and Elizabethtown Telephone Company has been incorporated with $4000 capital, to operate from Elizabethtown through Lewis, Keene, Westport, Willsboro, Essex, Chesterfield, Jay and Elba. The directors are A. J. Durand and A. E. Coonrod, of Elizabethown; F. A. Marvin and S. S. Beardsley, of Lewis; E. M. West of Reber; J. S. Laverty, of New Russia, and W. H. Lobdell, of Wadham's Mills.

NORTHVILLE, N. D.—The telephone company recently organized will build a line to Scatterwood Lake.

FARGO, N. D.—The articles of incorporation for the LaMoure County Telephone Company have been filed.

CRYSTAL, N. D.—Steps have been taken looking toward the construction of a telephone line here and in Hoople.

ROLLA, N. D.—F. Martineau has disposed of his telephone system in this county to the Northern Telephone Company.

NOME, N. D.—The Nome Mutual Telephone Company has been incorporated by Ole Hanson, M. H. Wilberg and others.

GRANVILLE, N. D.—The Union Telephone & Light Company, with a capital of $5000, has been incorporated by Oliver G. Nordmarken and Josiah H. Davies.

HANNAFORD, N. D.—The Hannaford Telephone Company has been incorporated with a capital of $1,000 by J. C. Mills, president, and A. O. Anderson, secretary.

CHALMERS, OHIO.—The Chalmers Co-operative Telephone Company has been formed, capital, $4,000, by J. Y. Higgins, Wallace Nace and others.

TIFFIN, OHIO.—The Telephone Woodworking Company has been incorporated with a capital of $50,000. Incorporators are W. H. Roose and J. A. Delford.

BOLIVAR, OHIO.—The Improved Home Telephone Company has been formed, capital, $10,000, by F. Briggs, J. M. Ramsey, R. L. Gelzert, E. F. Briggs and M. W. Briggs.

TAPPAN, OHIO.—The Tappan Telephone Company has been incorporated with a capital stock of $1500. The incorporators are C. B. Spray, F. H. Simpson, E. C. Spiker, D. C. Taylor and R. R. Pittis.

McCOMB, OHIO.—At the annual meeting of the Home Telephone Company, the following officers were elected: President, J. C. Bright; vice-president, C. B. Hull; secretary, A. L. Frucha; treasurer, M. W. Swartz.

FREEPORT, OHIO.—The Brush Fork Independent Telephone Company has been incorporated with a capital stock of $3000. The incorporators are M. W. Simpson, E. B. Pumphrey, S. G. Cole, C. W. Holtz and S. C. Forsythe.

ANDOVER, OHIO.—The Bell Telephone Company and the Andover Company have connected their lines at Andover. This will give quick communication with such points as Cleveland, Pittsburg, Youngstown, Ashtabula, Conneaut and Jefferson.

BLANDFORD, OHIO.—The petition of the American Telegraph & Telephone Company to extend its line through Blandford has been granted.

KAW CITY, OKLA.—D. W. Campbell will erect three telephone exchanges; one here, one at Fairfax and the other at Kedee.

KLAMATH FALLS, ORE.—The Klamath Telephone & Telegraph Company, capital $15,000, has been incorporated by Louis Hessig, J. H. Hessig and others.

YORK, PA.—The Bell Telephone Company proposes to expend $100,000 in improvements here.

PITTSBURG, PA.—The Federal Telephone Company has notified its patrons and the borough officials at East McKeesport that it intends to retire from business. The company asks for the repeal of the company's franchise in the borough and the surrender of its bond. The Borough Council will refuse to surrender the charter until a sufficient amount of money is deposited to defray expenses connected with legislation necessary.

ROCK HILL, S. C.—The Rock Hill Telephone Company has been granted a 10-year franchise by the town. The city reserves the right to buy the plant at any time. Maximum rates of $2 for residences and $3 for business houses per month are also established.

ETHAN, S. D.—The Davis County Telephone Company will erect a new line from this city to Hillside.

CLARK, S. D.—The Clark County Mutual Telephone Company has been incorporated with $15,000 capital.

WENTWORTH, S. D.—The Battle Creek Farmers' Telephone Company has decided to increase its capital from $3,000 to $15,000.

MILBANK, S. D.—The Grant County Telephone Company, with a capital of $100,000, has been incorporated by H. Cunningham, W. G. Ackerman and others.

NASHVILLE, TENN.—Offices are to be opened at once in Nashville by the Home Telephone Company, which has asked the City Council to allow the people to vote upon the granting of a franchise for an independent telephone system.

WAXAHACHIE, TEX.—The Ellis County Independent Telephone Company has now direct connection with Hillsboro, Waco, Houston and other cities. A long-distance line connecting this city with Waco will soon be completed.

PROVO, UTAH.—The Independent Telephone Company, of Salt Lake City, has been granted a franchise to operate its system in this city.

BRIGHAM CITY, UTAH.—An ordinance granting a franchise to the Independent Telephone Company, of Salt Lake City, has been granted by the City Council.

SALT LAKE CITY, UTAH.—Articles of incorporation of the Bear River Valley Telephone Company, with headquarters at Tremonton, have been filed with the Secretary of State. The company is capitalized at $25,000.

BRIGHAM CITY, UTAH.—The County Commissioners have passed an ordinance granting a telephone franchise to the Utah Independent Telephone Company for the erection and maintenance of a telephone line in Box Elder County, Utah.

SALT LAKE CITY, UTAH.—It is announced that $500,000 will be expended during the next year by the American Telephone & Telegraph Company in improvements to the company's system in the intermountain states. Of this amount $250,000 will be spent in Utah, $150,000 in Montana, $70,000 in Wyoming and over $50,000 in Idaho.

COFFEE, VA.—The Bedford and Campbell County Telephone & Telegraph Company has been incorporatted. Dr. F. W. Nelson, Forest, Va., is president; B. D. Clay, secretary and treasurer, Coffee, Va. Capital stock, $5000.

CHENEY, WASH.—The Pacific States Telephone & Telegraph Company will erect a line between here and Spokane.

BELLINGHAM, WASH.—The Farmers' Mutual Telephone Company, having as its object the connection by telephone of the rural systems, has been organized. Ed. Brown, of Custer, is president; W. H. Townes, of Lynden, secretary and treasurer.

HOLLANDALE, WIS.—The Blanchardville and Hollandale Farmers' Telephone Company has filed an amendment increasing its capital from $1,000 to $2,000.

HAGER, WIS.—The Hager Telephone Company has been organized to build a telephone line from this village to Diamond Bluff and thence down the Trimbelle Valley.

OCONOMOWOC, WIS.—The Badger Telephone Company, of Oconomowoc, recently organized, has chosen the following officers: Vice-president, J. J. Reid; secretary, H. E. Rosenow.

ORILLIA, ONT.—A tender from a Toronto syndicate will be submitted to the town of Orillia, with a view of installing a municipal telephone system in the town. The cost of telephones to users, under the proposed system, will be from $15 to $20 per year.

STRATFORD, ONT.—The Bell Telephone Company has agreed with the City Council of Stratford to place its wires underground in the main business portion of the city. The company estimates that the necessary expenditure to complete the work will be in the neighborhood of $11,000.

ST. JOHN, N. B.—The city of St. John has a bill before the Provincial Legislature providing for a municipal telephone system. The aldermen of the city apppeared before the House committee and stated that 1,000 persons had agreed to subscribe for ten years. It was estimated that a first-class automatic system, with a subway for wires with a capacity of 4,000 telephones, could be established for $170,000. The New Brunswick Telephone Company opposed the bill, claiming that it had recently expended $120,000 in establishing an up-to-date plant, and that its service was a satisfactory one. It was also claimed that St. John was getting cheaper telephone service than any other city of the same size in Canada.

# Electric Light and Power.

CARBONHILL, ALA.—It is proposed to construct water works and an electric light plant at a cost of $25,000 to $35,000. No engineer has been selected as yet. J. S. Shannon is chairman of the Light Committee.

MONTGOMERY, ALA.—The Montgomery Light & Water Power Company has changed hands. Mr. W. F. Vandiver as president has sold his holdings in said company to Mr. McMillan, of New York. The company will shortly be reorganized. The company furnishes lights to the city of Montgomery and electric power to each of the two electric railway companies of this city.

LITTLE ROCK, ARK.—The Merchants Investment Company has been incorporated with a capital of $250,000. Incorporators: C. J. Kramer, Wm. S. Mitchell, J. B. Wishendorff and others.

ANAHEIM, CAL.—The Board of City Trustees has authorized Engineer A. L. Lewis to prepare a report on the extension of the electric light plant and an increase of the water supply.

SEBASTOPOL, CAL.—Bids will be received, June 6, by Wm. T. Searles, Town Clerk, for a franchise to construct and operate along the streets, poles, wires, transformers, etc., for the transmission of electricity for electric light and power purposes and to operate electric light and power systems within said town.

STAFFORD SPRINGS, CONN.—Alden M. Young, president and treasurer of the Stafford Springs Electric Light & Gas Company, has applied to the Superior Court for the appointment of a permanent receiver for the corporation.

MONTICELLO, FLA.—The Monticello Power Company has been incorporated, with a capital of $10,000.

EUSTIS, FLA.—Armstrong & Smith have petitioned Council for a franchise for water works and an electric light plant.

ALACHUA, FLA.—The Alachua Ice & Water Company has been incorporated with a capital of $25,000. It will construct an electric light plant. Incorporators: R. L. Stringfellow, R. R. Livingston and others.

OCALA, FLA.—Letters patent have been issued for the Florida Power Company, at Ocala, $300,000 capital, to conduct a business of leasing and selling of water power rights, including the construction of dams for the purpose of generating electric power. W. N. Camp, Clarence Camp, R. F. Brewer, Geo. D. Munsing and O. S. Green are the incorporators.

HAWKINSVILLE, GA.—The city of Hawkinsville has rescinded a 10-year contract offered by the Hawkinsville cotton mills to light the streets, and an election will probably be held on the question of issuing bonds for a municipal electric lighting plant.

AMERICAN FALLS, IDAHO.—The new plant of the American Falls Power, Light & Water Company has been completed and is supplying electrical power to Pocatello and other points. The plant has a capacity of 2500 horse power, of which 1250 is at present being utilized.

WEISER, IDAHO.—In regard to the construction of a power plant on Weiser River, the work is not assured yet, but it will probably be done. If the plant is constructed it will cost $50,000. Pitts, Ellis & Co. are interested in this plant. A. E. Fox, of Weiser, is the engineer.

CARLINVILLE, ILL.—C. W. Carr, of Virden, is interested in the construction of an electric light plant in Carlinville.

PLAINFIELD, IND.—W. W. Wilson, of Danville, has received the contract for constructing an electric light plant at Plainfield.

GIRARD, KAN.—The city of Girard has engaged W. K. Palmer, consulting engineer, Kansas City, Mo., in connection with improvements about to be made in the electric lighting plant and water works of this city.

DANVILLE, KY.—The Danville Light, Power & Traction Company has been organized in this city by electing Hon. Chas. C. Fox, local attorney, as president of the concern. The other officers chosen were: Walter T. Scott, of Georgetown, Ky., vice-president; Arnold Honegger, of St. Louis, Mo.; secretary, treasurer and general manager.

LAWRENCE, KAN.—An option on the Lawrence electric light plant has been given to a company to be known as the Lawrence Light, Heat & Power Company. The stockholders of the new company are Lawrence men, and it is the intention to take over the property at once and to make repairs, changes and improvements. It is planned to spend about $30,000 at once in an enlargement of the plant so it will be adequate to meet the demands upon it.

LAKE CHARLES, LA.—The Lake Charles Ice, Light & Water Works Company, it is stated, has awarded contracts for equipment for its plant as follows: To the Westinghouse Electric & Mfg. Company, Pittsburg, Pa., 3 generators, a converter, 2 transformers and a 9-panel switchboard; to the Alberger Condenser Company, of Newburg, N. Y., a surface condenser; Casey & Hodges Mfg. Company, of Chattanooga, Tenn., boilers, and to the Dodge Mfg. Company, of Mishawaka, Ind., a rope-driving device.

EASTHAMPTON, MASS.—The directors of the Easthampton Gas Company have voted to construct a new electric light plant for street lighting.

BUCKFIELD, MASS.—The Buckfield Water, Power & Electric Light Company has been incorporated with a capital stock of $25,000. The officers are: President, H. A. Irish; treasurer, C. N. Taylor. Directors: C. M. Irish, I. W. Shaw and R. H. Morrill.

WAKEFIELD, MASS.—This town runs its own electric plant, water plant, gas plant, gas stove store, gas jobbing department, electric jobbing department and each department claims to be making a good profit. In the town's annual report, just issued, nevertheless, the finance committee of the town, after complaining about some of the State taxes, continues: "Our internal affairs, over which we have direct control, have increased all out of proportion to the increase of our receipts. Practically all the departments have presented an increase in their fixed charges which we do not see any way of avoiding and we do not doubt that the money is actually necessary and will be expended judiciously and to the advantage of the town. Our aim has been in considering these appropriations to keep the amounts below last year. In view of all the above, heroic measures must be taken by the town."

BATTLE CREEK, MICH.—The citizens have voted in favor of municipal ownership of the gas and electric light plants.

TRAVERSE CITY, MICH.—A committee has been appointed to visit plants in certain Michigan cities and prepare prices on a plant of from 100 to 200 light capacity.

SAULT STE. MARIE, MICH.—The incorporation papers of the Edison Sault Water Power Company have been filed with the Secretary of State. The capital stock of the corporation is $10,000.

DULUTH, MINN.—Water and lighting bonds amounting to $140,000 were sold April 10.

MELROSE, MINN.—F. J. Weiser, City Clerk, will receive plans for water works and an electric light plant.

SOUTH ST. PAUL, MINN.—The South St. Paul Power, Heating & Lighting Company is about to petition the Village Council for a franchise. Emil Erick and John Coates are among the incorporators.

MOORHEAD, MINN.—Bids will be received, May 1, by H. E. Roberts, City Clerk, for furnishing a 300-kw. generating unit for the electric light plant, at a probable cost of $20,000. E. P. Burch, Minneapolis, is the engineer.

GLASGOW, MONT.—Estimates have been submitted to the Mayor and Council for water works and an electric light plant. A. W. Mahon is the City Engineer.

PONCA, NEB.—The lighting bonds question did not carry at the recent election and it is proposed to take another vote.

OMAHA, NEB.—By unanimous vote the City Council in general committee meeting decided to enter into a contract with the Omaha Electric Light & Power Company to renew its contract for four years from next January 1, at its own proposition, amended, however, to provide that at the end of three years the city may rescind the balance of the contract if it then has established a municipal lighting plant.

CARSON CITY, NEV.—The Walker River Electric Company has recently been organized and will build a telephone line from Smith Valley to this city.

NEWARK, N. J.—The American Beck Electric Lighting Company has been formed, capital $125,000. Incorporators: Eli Teeter, Thomas J. Butler and Theodore D. Gottlieb.

NEWARK, N. J.—The New Jersey Beck Electric Lighting Company has been formed, capital $125,000. Incorporators: Charles A. Woodruff, Thomas J. Butler and Eli Teeter.

BEVERLY, N. J.—The Cinnaminson Electric Light, Power & Heating Company, of Riverside, has secured the contract for lighting the city by electricity for 5 years, at $2,850 per year.

BUFFALO, N. Y.—The Board of Aldermen has passed the ordinance granting a franchise to the Iroquois Electric Company.

PHOENIX, N. Y.—The Phoenix Fuel, Light & Water Company, of Phoenix, has been incorporated with a capital of $100,000 by J. O. Hawley and L. C. Hall, of Canandaigua.

LONG ISLAND CITY, L. I., N. Y.—Bids will be received until May 1 by C. B. J. Snyder, Superintendent school buildings, New York City, for installing electric equipment in the addition to School No. 71, Borough of Queens.

BINGHAMTON, N. Y.—Bids are wanted, May 8, for lighting the streets with 374 or more electric arc lights of 2,000 candle-power, from July 14, 1905, to burn from dusk to daylight every night, with proportionate rebate for outages; also price per kilowatt for lighting the city hall and other public buildings. D. C. Herrick, City Clerk.

NEW YORK, N. Y.—The following are the bids opened April 20 by Geo. W. Best, Commissioner of Bridges, for the construction of an electric lighting station and equipment at Tompkins St. and Delancey Slip for the Williamsburg Bridge: Northeastern Construction Company, $51,973; R. J. Gerstle, $49,381; Kelly & Kelley, $55,900; Edw. Burham, $56,437, and Johnston Livingston, Jr., Co., $49,679.

FAYETTEVILLE, N. C.—The Fayetteville Gas & Electric Company has been sold to J. H. Martin, of New York.

HENRIETTA, N. C.—The Henrietta cotton mills are building a large power plant and about 1000 horse-power will be transmitted to the big mill at Caroleen, N. C.

GREENSBORO, N. C.—Mr. R. H. Gamwell is general manager of the Greensboro Electric Company, and we learn that the Greensboro Railway & Light Company, has been chartered by the Secretary of State with $750,000 authorized capital for the purpose of purchasing, constructing and operating street railways and light plants, the subscribers to the stock being F. R. Williamson, of Flemington, N. J.; R. H. Gamwell, of Greensboro; W. M. Wherry, Jr., and W. A. Morgan, of New York, and W. W. Gamwell, of Pittsfield, Mass.

GRAND FORKS, N. D.—It is proposed to construct an electric light plant at a cost of $30,000. J. J. Smith is city engineer.

DAYTON, OHIO.—The large power plant formerly owned by Jas. T. Wolfe has been sold at public auction to the Germania Building Association for $10,000.

CLEVELAND, OHIO.—The People's Electric Light & Power Company has been incorporated with a capital of $10,000, by H. I. Emerson, W. McBride, D. F. Crane and others.

BARNESVILLE, OHIO.—The contract for lighting the village by electricity has been awarded to the Barnesville Gas & Electric Light Company, of Barnesville, at $75 per light per year for arc lights, and $19 per light per year for incandescents.

SPRINGFIELD, OHIO.—The People's Light, Heat & Power Company has been incorporated with a capital stock of $2,000,000. The incorporators are F. M. Hagan, Walter L. Weaver, J. L. Zimmerman, A. H. Kunkle, W. W. Keifer and F. H. Clarke.

HARRISBURG, ORE.—The City Council has decided to issue bonds for water works and an electric light plant.

SALEM, ORE.—The Baker City Light & Power Company has been formed, capital $400,000. C. A. Johns, J. H. Parker, F. N. Averill are the incorporators.

LA GRANDE, ORE.—The Grande Ronde Electric Company and the La Grande Storage Water Company have consolidated. The directors of the company are J. A. Thronsen, Walter M. Pierce, W. G. Hunter and T. H. Crawford. Power on the Cove line will be developed first. The Grande Ronde Company gets power from Cove and the La Grande Company from Morgan Lake.

ALLENTOWN, PA.—The Merchants' Light & Power Company has petitioned Council for a light and power franchise.

SCRANTON, PA.—An ordinance has been introduced in Council granting a franchise to the West Scranton Light, Heat & Power Company.

SUNBURY, PA.—Geo. W. Wagenseller, of Middleburg, and David Goltstein, of Pittsburg, have secured electric light franchises in Sunbury, Selinsgrove and Middleburg. A trolley line will also be constructed from Sunbury to Mifflintown.

VERMILLION, S. D.—The citizens have voted in favor of municipal ownership of the electric light plant.

NASHVILLE, TENN.—Following are the bids opened on April 18 by the Board of Public Works for furnishing and installing a complete 400-hp. generating set in the city lighting plant: Braid Electric Company, $11,995; Bullock Electric Mfg. Company, $12,317.

OGDEN, UTAH.—A company will shortly be organized here to establish an electric lighting plant, $30,000 having already been subscribed for the purpose.

WELCH, W. VA.—The Citizens' Light & Water Company, of Welch, has been incorporated by the Secretary of State. Capital stock, $25,000. Incorporators: W. Burbridge Payne, James A. Strather, Edgar P. Rucker, I. J. Rhodes, M. W. Hutson, Louis Morse, C. D. Brewster, A. Q. Letz, L. Masil, Welch, W. Va.

EAU CLAIRE, WIS.—The Eau Claire Gas Light Company has increased its capital stock to $250,000.

BURLINGTON, WIS.—It was voted April 4 to construct an electric light plant. J. T. Brasch is city clerk.

OTTAWA, ONT.—An important epoch in electrical development in Ontario has been marked by the action of the Railway Committee of the Provincial Legislature. A Government clause has been inserted in a bill retaining to the Government the right to transmit electricity from water powers to the municipalities. This step probably foreshadows an advanced policy on the part of the Government for the development of water resources in the interests of municipalities. Public ownership of public utilities seems to be the object in view.

## The Electric Railway.

HARTFORD, CONN.—Boston capitalists, through James L. Shaw & Co., of that city, have bought the Hartford, Manchester and Rockville trolley system and charter of the company, with the right to build from Rockville to Worcester, Mass. This will be built, giving a trolley from here to Boston, twenty-three miles shorter than the steam road.

PAYETTE, IDA.—A franchise for an electric railroad in the Payette Valley has been granted by the City Council to William Mainland. An electric plant will be installed by the incorporators.

LEWISTON, IDA.—There is a movement on foot to extend the Lewiston & Southeastern Electric Railway from Grangeville to Boise. The officers of the Lewiston & Southeastern Company are: President and general manager, Col. Judson Spofford; vice-president and chief engineer, W. H. Hill; secretary and treasurer, F. J. Randolph.

GLASGOW, KY.—Articles of incorporation have been filed with the County Clerk of Larue County for an electric railway between Hodgenville and New Haven, via Buffalo. The capital stock is $5000, to be increased according to the amount needed for the completion of the proposed line.

PORTLAND, ME.—The Railway Electric Power Company has been organized for the purpose of providing standard and other railways with electric traction, for moving passenger and freight traffic, etc., with $1,500,000 capital stock, of which $300 is paid in. The officers are: President, H. L. Cram, of Portland; treasurer, A. F. Pine, of Portland.

BOSTON, MASS.—The Railroad Commissioners have authorized the Plymouth County Railway Company to issue $125,000 original capital stock for the construction of its line.

MINNEAPOLIS, MINN.—The Twin City Rapid Transit Company's directors have declared the regular common quarterly dividend of 1¼ per cent. payable May 15.

MISSOULA, MONT.—The City Council has granted a franchise for an electric street railway to J. R. Wharton, of Butte, who represents the Senator W. A. Clark syndicate.

GREAT FALLS, MONT.—Dr. Ernest Crutcher, of this city, has been granted a franchise by the County Commissioners for the construction of electric railways in various portions of the county. Similar franchises in other counties will be asked for. The plans include the building of lines to Lewiston and Choteau.

KANSAS CITY, MO.—W. B. Strang, of New York, will construct, this summer, a line twenty miles long between Kansas City, Mo., and Olathe, Kan., which will have the effect of making the latter city practically a suburb of the former.

FARMINGTON, MO.—There was a meeting of the stockholders of the St. Francois County Railway Company in Farmington a few days ago and a new board of directors was elected. The new directors met and organized by electing the following officers: President and treasurer, A. J. Zwart; vice-president, C. H. Bosworth, and secretary, F. L. Tompkins.

TRENTON, N. J.—The New Jersey & Pennsylvania Traction Company is planning extensive improvements upon its Trenton, Lawrenceville & Princeton road.

ROCHESTER, N. Y.—The Railroad Commissioners have granted the application of the Rochester Railroad Company for an increase of capital from $5,500,000 to $6,000,000 for the purpose of construction and reconstruction.

HUDSON HEIGHTS, N. Y.—The Edgewater & Hudson View Construction & Traction Company proposes to build an electric railway on the river road from the northerly end of the Borough of Edgewater, running south through Edgewater township, North Bergen, town of Guttenberg and and partly through the town of West New York to a point near the old West Shore Ferry landing. The line will be single track and will extend a distance of 4½ miles. The officers of the company are: President, August Sieber; vice-president, Thomas Kerrigan; secretary, Wm. M. Schultz; treasurer, Robert H. Sanders; counsel, Albert W. Yening.

CLEARFIELD, PA.—The Northern Cambria Street Railway Company is about to build and equip 12 miles of its proposed 25-mile system. The power station will be equipped with 600 hp. boilers and engines, the generators to correspond. The officers are: President, W. H. Denlinger, Patton, Pa.; engineer, E. W. Hess, Clearfield, Pa.

WOONSOCKET, R. I.—Duly authorized representatives have executed contracts whereby the Woonsocket Electric Machine & Power Company agrees to furnish electric power for 20 years to the Woonsocket Street Railway Company, the Columbian Street Railway Company and the Providence and Burrillville Street Railway Company. All three street railway companies have had annual meetings and elected the old officers, and, in addition, A. D. Thayer, of Franklin, was elected a director of the Woonsocket Street Railway Company.

SPARTANBURG, S. C.—Plans are being considered for the Carolina Traction Company's line, to be 66 miles long, with terminals at Clinton, Laurens, Union and Spartanburg, all in South Carolina. An engineer has not yet been employed, and the promoters are ready to finance the project. Probably $300,000 will be supplied by persons along the road, but the remainder of $1,500,000 will be sought for elsewhere.

NASHVILLE, TENN.—A canvass is being made for subscriptions to an electric railway from Nashville, Tenn., to Huntsville, Ala., via Shelbyville, Tenn.

KNOXVILLE, TENN.—A $50,000 bond issue bill has passed the Tennessee Legislature for Sevier County, which permits the delivery of this sum to the Cincinnati backers of an electric railway project, the line to run from Knoxville, a distance of 30 miles.

NASHVILLE, TENN.—The directors of the Nashville Interurban Railway have filed an amendment to the charter of the company, authorizing an increase in the capital stock from $50,000 to $400,000. The company is a consolidation of the two companies which proposed to build electric railways from Nashville to Columbia and Gallatin. The directors are: W. J. Whitthorne, Jos. Frank, John A. Pitts, H. E. Howse, D. K. Spillers, N. Baxter, Jr., J. H. Connor and John T. Landis.

STAUNTON, VA.—The property of the City Street Car Company was sold under foreclosure here a few days ago for $20,500 by John M. Spotts and associates. The property embraces some 8½ miles of track.

VICTORIA, B. C.—The directors of the British Columbia Electric Railway Company have approved an agreement providing for the electrical operation of a railway line between Vancouver and the town of Stevetson. An increase of $1,000,000 in capital has been authorized.

KINGSTON, ONT.—After three weeks of inaction, with the cars lying motionless in the barns, the bondholders of the street railway of the city of Kingston have offered the plant to the city for $125,000, which is $75,000 less than the bonds. They also offered to keep the road running if granted a low rate for power until the city could take the railway over. It is thought that the road will ultimately be sold at auction.

## New Industrial Companies.

THE ROSS ELECTRIC SPECIALTY COMPANY, of Cleveland, has been formed, capital $10,000, by W. H. Wildow, M. Aldredge, George W. Ross, J. W. Burrell and H. C. Gahn.

THE EASTERN ELECTRIC COMPANY, of Dover, Me., has been incorporated with a capital of $10,000. The officers are: President, W. C. Woodbury; treasurer, F. E. Guernsey, Dover.

THE UNITED STATES ELECTRIC PORCELAIN COMPANY, of Camden, N. J., has been formed; capital $50,000. Incorporators: B. W. Payne, William H. Francis and M. A. McKee.

THE TESLA MACHINE COMPANY, of New York, has been incorporated to manufacture air compressors. Capital, $300,000. Directors: Nikola Tesla, Langdon Greenwood, New York, and William Andres, Brooklyn.

THE RAILWAY ELECTRIC POWER COMPANY, of Portland, Me., has been incorporated to furnish electric power for passenger traffic, etc., with a capital stock of $1,500,000. The president is H. L. Cram; treasurer, A. F. Pine, Portland.

THE LAFAYETTE MANUFACTURING ELECTRIC COMPANY has incorporated and will establish a plant to manufacture Hornberger transformers and other electrical inventions. Mr. Hornberger will have charge of the new factory in this city.

THE UNIVERSAL ELECTRIC CLOCK COMPANY, of New York City, has been incorporated to manufacture clocks and advertising machines. The capital stock is $25,000. The incorporators are Abe S. Kuhn, Albert N. Stein, John Stein and Samuel Schiff, New York City.

THE TORNQUIST ELECTRICAL MANUFACTURING COMPANY, of Davenport, Ia., has been incorporated with a capital stock of $30,000. The officers are: President, J. A. Tornquist; vice-president, Geo. L. Osborn; secretary and treasurer, George Barker.

THE U. S. ELECTRIC PORCELAIN COMPANY, of Camden, N. J., has been incorporated to manufacture electric supplies, earthenware, clays, glasses, etc., with a capital stock of $50,000. The incorporators are B. W. Payne, William H. Francis and M. A. McKee, of Camden.

THE INDIANA HYDRAULIC COMPANY has been organized at Frankfort, Ind. Eugene Rush is president and N. W. Hanna, secretary. It will incorporate with a capital of $200,000. The company proposes to build a dam on Wildcat River. Work will begin on the dam within a month.

THE NIAGARA-WELLAND POWER COMPANY, Niagara Falls, Ont., has been formed with a capital of $5,000,000 to construct a plant at St. Catherines and transmission lines for the distribution of power in Western Ontario. Harry Symons is president, Roderick J. Park, consulting engineer, both of Toronto.

THE MILLER-COLLINS COMPANY, of New York City, has been incorporated with a capital stock of $50,000, with the object of carrying on an engineering and contracting business. The incorporators are S. Fischer Miller, South Orange, N. H.; D. C. N. Collins, Bayonne, N. J., and George Price, Jr., New York City.

## Legal.

MR. EDISON ENJOINED.—By a decision handed down April 20 by Judge Hazel, in the United States Circuit Court for the Southern District of New York, Mr. Thomas A. Edison, the Edison Phonograph Works and the National Phonograph Company were enjoined from operations in this State. For several years the New York Phonograph Company has had exclusive licenses in this State. The licenses were procured from the North American Phonograph Company, of which Edison was at one time president. Some time after the granting of the licenses the North American Company went into the hands of a receiver. Edison personally purchased all the assets of the company at a receiver's sale. Later he organized the National Phonograph Company. For several years the new company sold and leased phonographs and supplies in this State, disregarding, it is said, the licenses held by the New York Phonograph Company. The latter company finally brought suit to protect its rights. The decision is supplemental to one rendered by Judge Hazel last January, in which he directed Mr. Edison and the other defendants to account to the New York Phonograph Company. Judge Hazel at that time declined to grant an injunction in respect to future sales on the ground that the exclusive licenses were no longer in force. Counsel for the New York Phonograph Company got a rehearing, resulting in a decision which entitles the New York company both to an injunction and an accounting. The injunction will, it is stated, prevent Mr. Edison from selling phonographs, records and supplies in this State except through the New York company.

## Personal.

MR. AUSTIN BURT.

MR. AUSTIN BURT, the newly elected president of the Iowa Electrical Association, is general manager of the Waterloo & Cedar Falls Gas & Electric Light Company. Mr. Burt was born in Detroit 35 years ago and received a public school education, later going to Cornell University. Before completing his course as mechanical engineer at Cornell, he left to accept a position with the E. P. Allis Company, and for five years was assistant to Mr. Edwin Reynolds. In 1900 he returned to Cornell to complete his course and get his degree as mechanical engineer. His graduating thesis was on a test of the Buffalo street railway, of which he had charge. Upon graduation he was elected a member of Sigma Xi, the scientific honor society, and also won the Sibley prize in mechanical arts, both of which serve to show his high attainments as an engineering student. Upon graduation he took the management of the Cedar Falls Light, Heat & Power Company. In 1902 this company was consolidated with the one at Waterloo, and Mr. Burt became superintendent of the electrical department. Later he was made general manager of the whole property. He has always been a most useful member of the Iowa Electrical Association, and the Association has made a very wise choice in placing him at the head for the coming year. His ability to thoroughly analyze all operating problems and to make intelligent operating statistics in bettering conditions, make him valuable both to his company and to the Association.

MR. F. W. HILL, recently with the Stanley Electric Mfg. Company, has become chief engineer of the Phoenix Electric Company, of Mansfield, Ohio.

MR. F. O. BLACKWELL read a paper on "Niagara Power" before the Toronto branch of the American Institute of Electrical Engineers, April 14.

MR. THADDEUS AVERY, JR., chief engineer of the Sawtooth Electric Power Company, Nome, Alaska, was married April 12, at San Francisco, Cal., to Miss Stella Evelyn Morse.

MR. J. H. HALLBERG on April 18 delivered a lecture before the Electrical Engineering Society of Columbia University, on the application of electricity to heavy freight and trunk line railways.

MR. THOMAS CARR POWELL, brother of Mr. Charles D. Powell, general agent of the Westinghouse Electric & Mfg. Company, has been appointed fifth vice-president of the Southern Railway.

MR. C. F. WAGONER has resigned as manager of the municipal electric light and water works plants of Louisville, Ga., to accept the position of first assistant mechanical engineer of the terminal station, Atlanta, Ga.

MR. W. F. KINGMAN, who has for some time been general manager of the Sault Ste. Marie Edison Light & Power Company, has accepted a position as manager of the power department of the Detroit Edison Company.

MR. JOHN M. MACK, president of the Keystone Telephone Company, of Philadelphia, has resigned. Mr. Mack was one of the principal promoters of the enterprise, and has been one of its leading spirits since its inception.

MR. JACOB E. RIDGWAY has been chosen president of the Keystone Telephone Company, of Philadelphia, to succeed Mr. John M. Mack, resigned. Mr. Ridgway is the president of the Quaker City National Bank, and a well-known capitalist of Philadelphia.

MR. WILBUR B. DRIVER has disposed of his interest in the Driver-Harris Wire Company, of which he was president, and will devote himself to the sale of special materials to meet particular requirements. Among these will be some new and improved resistance wires.

MR. F. C. FINKLE, chief hydraulic engineer of the Edison Electric Company, Los Angeles, Cal., calls our attention to an error in the spelling of his name in connection with the Los Angeles article published in our issue of March 25 last. The initials given there were F. E., which are evidently those of another person.

MR. MAURICE COSTER has taken charge of the export department of the Westinghouse Electric Mfg. Company. Mr. Coster became connected with the Westinghouse Company in 1888, and was formerly manager of its Chicago office. From 1899 until recently he was sales manager of the Societé Anonyme Westinghouse in France.

MR. C. E. L. BROWN, of Brown, Boverie et Cie., has been retained by the London County Council in connection with a project to construct three electric plants to supply all of London and the suburbs under jurisdiction of the Council. Each plant is to consist of turbo-generators of 10,000 nominal and 20,000 maximum horsepower, making a total on the latter basis of 360,000 horse-power.

MR. J. E. DAVIDSON, who has been connected with the Port Huron (Mich.) Power & Light Company for the past six years as secretary, has resigned that position to accept a similar one with the Consolidated Light & Power Company, of Montpelier, Vt., which recently has been purchased by Mr. W. F. Davidson, of Port Huron. Mr. Davidson has also been city electrician of Port Huron for two years and is secretary and treasurer of the Michigan Electric Light Association.

MR. CHARLES F. BRUSH contributes to "Century" the first of a series of papers on great inventions described by their inventors. Mr. Brush's article relates to the history of arc and incandescent lighting, his early experience and experiments, the organization of the Brush Electric Company, etc. Among others who will contribute articles are Mr. Frank J. Sprague on "Electric Traction," Mr. Nikola Tesla on "The Transmission of Power" and Mr. George Westinghouse on "The Air Brake."

MR. F. H. JONES has been appointed general sales manager of the International Pump Company. During the past five years Mr. Jones has been manager of the air compressor and power pump departments and in charge of special Government work for this comany. Mr. Jones is a graduate of Cornell University, class of 1880; immediately after leaving school he entered this branch of work, engaging in the manufacturing, selling and sales management of pumping apparatus up to the present time.

MR. CHARLES S. POWELL has been promoted to the position of general agent of the Westinghouse Electric & Mfg. Company. Mr. Powell became connected with the Westinghouse Company in 1893, and prior to his departure for Europe in 1902 was manager of the Cleveland Westinghouse office. While in Europe he was assistant manager of the British Westinghouse Company, which duty brought him into close contact with the recent movement toward the electrification of British traction systems and railroad terminals.

MR. J. W. DODD, for the past five years with the English Electric Mfg. Company, at Preston, England, has returned to the United States. Mr. Dodd was associated with the Walker Company and went to England with the late Mr. S. H. Short to assist him in the engineering work in connection with the organization of the English Electric Mfg. Company. After the death of Prof. Short, in 1902, he carried on his work, having entire charge of the standardization of the line of direct-current machinery. This task having been completed, he has returned to this country, where, after reviewing the American railway engineering field, he will enter into active work.

# Trade Publications.

KRANTZ BUSHINGS.—Bulletin No. 12 of the H. Krantz Manufacturing Company, Brooklyn, N. Y., illustrates and describes its line of porcelain lined bushings and check nuts. The Krantz straight-line panel and Krantz knife switches are also shown.

SARCO CABLE FITTINGS.—Recent bulletins of the Sarco Company, 906 Sixth Avenue, New York, describe the Sarco single bushing, duplex flat bushing and combined outlet and junction box, all of which devices greatly facilitate the installation of steel-armored cable.

ELECTRIC BENCH GRINDERS.—In a notice of the booklet issued by the Northern Electrical Mfg. Company, Madison, Wis., the publication should have been designated No. 43 instead of No. 42. By another misprint the width of the emery wheels was stated to be ¼-in., instead of ¾-in.

ELECTRICAL CATECHISM.—The third number of the "Electrical Catechism," published in serial form by the National Electric Company, Milwaukee, U. S. A., is devoted to electrical measuring instruments. Diagrams are given showing the application of the voltmeter, ammeter and Wheatstone bridge.

CHASE-SHAWMUT BULLETIN.—The Chase-Shawmut Company, Newburyport, Mass., has issued a bulletin (No. 30) describing two of its latest devices. One of these is the Boston cable clip, which is claimed to be the simplest, strongest and best device of its kind thus far offered. The Shawmut-Marlin cable handle is also illustrated and described.

CENTRAL ELECTRIC CIRCULARS.—"Speaking Lampwise" is the title of a circular issued by the Central Electric Company, Chicago, in the interest of the Columbia incandescent lamp; and which is rendered unique in appearance by a peculiar double cover. Another circular in folder form sets forth the advantages of the "Hubbell" labor-saving shade holder.

N. S. STORAGE BATTERIES.—The N. S. Electric Storage Battery Company, Ltd., with works at Horton Kirby, Kent, England, has issued a catalogue describing its factory and illustrating the various types of storage batteries which it manufactures. The N. S. battery is the invention of Mr. J. T. Niblett, who is the author of a standard treatise on the storage battery.

WESTINGHOUSE FAN MOTORS.—Two very handsome pamphlets have been issued by the Westinghouse Electric & Manufacturing Company, one devoted to alternating-current and the other to direct-current fan motors. In addition to illustrations of the various types of fans and their details, a number of well-executed engravings show the application of the electric fan to various uses.

LAMB MOTORS.—In a recent circular the Lamb Electric Company, Grand Rapids, Mich., describes its high-duty, direct-current motor, which is manufactured in sizes from 2 to 15 horse-power. These motors are designed and constructed along the lines of street railway motors and are stated to be capable of starting under extremely heavy loads without sparking, and adapted for long runs under heavy work.

ROCHESTER GAS ENGINE GENERATOR.—Circular No. 52 of the Rochester Electric Motor Company, of Rochester, N. Y., describes its line of generators specially designed to be run by ordinary gas or gasoline engines. The machines manufactured range from .8 to 20 kw., that for 11 kw. being illustrated in the circular. The generator, which is of very handsome appearance, is provided with a heavy fly wheel.

GUY ANCHORS.—With the title "Anchors That Hold," W. N. Matthews & Bro., St. Louis, Mo., have issued a handsome catalogue in the interest of the Stombaugh guy anchor. Several excellent half-tone engravings give views of the manner in which the anchor is installed. A report by Professor R. C. Carpenter is also included, giving an account of a test of the holding capacity of the anchor, two illustrations of the method of test being included.

FORT WAYNE FANS.—In a catalogue with a very artistic cover in colors and an inner cover of a delicately embossed semi-transparent paper, the Fort Wayne Electric Company shows the various types of "Wood" fan motors it has prepared for the coming season. This embraces all the usual types of fans, and a particularly novel new type. This latter is a suspended revolving fan motor, and the illustrations show how it may be used as a ceiling fan or simply attached to an electrolier.

SCHAEFFER & BUDENBERG CATALOGUE.—The latest issue of the Schaeffer & Budenberg catalogue, dated April, 1905, forms, with its hundreds of illustrations, a complete pictorial representation of the art dealing with engine and boiler room accessories. More than a half hundred forms of pressure gauges and more than a score of tachometers are shown. One section is devoted to gauge listers, and other interesting sections illustrate anemometers, draft gauges, thermometers in immense variety, test pumps, calorimeters, etc.

BROWNING BULLETINS.—We have at hand seven bulletins issued by the Browning Engineering Company, Cleveland, O., which are models of what such publications should be. They are printed in regular octavo form and on paper fitted for half-tone engravings, while the descriptions are concise, to the point and not handicapped by perfunctory selling claims. Five of the Bulletins have for a subject various types of locomotive cranes; one is devoted to an automatic grab bucket and another describes a coil-spring friction clutch.

COOPER HEWITT MERCURY VAPOR LAMPS.—Bulletin No. 6 of the Cooper Hewitt Electric Company describes type "K" Cooper Hewitt mercury vapor lamp and also type "H," two of the latter being equivalent to one of the former. These lamps are for direct current only and for service in indoor general illumination. The larger type is particularly adaptable for illuminating factories, machine shops, warehouses, etc., and the smaller type for lighting smaller areas and rooms with low ceilings. A reflector is also shown which can be adjusted to give any desired distribution of light.

SMALL DIRECT-CURRENT MACHINES.—Bulletin No. 51 of the Crocker-Wheeler Company, Ampere, N. J., presents the advantageous features of Form F, direct-current machines which can be used either as motors or generators. These machines have become thoroughly standarized, so that duplicate machines and spare parts may be readily shipped from stock. The bulletin illustrates a number of installations where the motors are used for direct driving. These equipments include refrigerating machines, turret lathes, printing presses, radial drills, pressure blowers and embossing presses.

# News of the Trade.

H. M. BYLLESBY & COMPANY have been appointed managers and engineers of the gas and electric properties of the San Diego Consolidated Gas & Electric Company, of San Diego, Cal.

KOHLER BROS., contracting electrical engineers, with main offices in Chicago, have opened a New York office in the Metropolitan Life Building, Madison Square. Mr. Thos. H. Rodman is in charge of the office as Eastern manager.

THE BUCKEYE ELECTRIC COMPANY reports a continually increasing sale of Buckeye lamps in Mexico. Its entire business in the republic is handled directly by Mr. Chas. E. Sharp, Security Building, St. Louis, as general agent and distributor.

THE COOPER HEWETT COMPANY, consisting of Mr. Leon H. Cooper and H. B. Hewett, has been formed to represent at Louisville, Ky., the General Electric Company, the Buckeye Engine Company and the Stirling Water Tube Boiler Company. The company also undertakes the installation of complete power plants.

VARLEY MAGNET WINDING MACHINERY.—The Varley Duplex Magnet Company, Jersey City, in a circular letter, states that the exclusive right to use Varley automatic winding machinery has not been granted to a single firm, but that responsible parties who desire to operate under the Varley patents can arrange to do so.

E. W. BAILLARD, well known to inventors as a pattern and model maker, has moved his factory from Franklin Square to 18-24 Frankfort Street, corner William Street, New York. This is a new modern fireproof structure, named the Black Building, where everything is up-to-date, and where the manufacturing facilities are better than in Mr. Baillard's old quarters. In the new shop the electric drive will be used entirely, the large machines being equipped with individual motors.

ALLEN-BRADLEY CONTROLLERS.—The American Electric Fuse Company has supplied to the Western Electric Company Allen-Bradley electric controllers to equip all the new cranes being installed at the Hawthorne plant of that company. Other recent orders are from the George H. Smith Steel Casting Company, of Milwaukee; Lackawanna Steel Company, Bethlehem Steel Company, John A. Roebling's Sons Company, Otis Elevator Company, American Locomotive Company, Trenton Iron Company and Gould Storage Battery Company.

THE ROBB-MUMFORD BOILER COMPANY has acquired the plant and good-will of Edward Kendall & Sons, Boston, and will continue the manufacture of fire tube boilers, tanks and sheet iron work of all description, making a specialty of internally fired boilers. No change will be made immediately in the location of the business, and the company will during the present year occupy buildings now being erected at South Framingham, Mass., which will be equipped with all modern appliances for the manufacture of boilers and sheet-iron work.

ELECTRIC FANS IN FORGE SHOPS.—The relatively small but very complete forge shop equipment recently installed by the B. F. Sturtevant Company, of Boston, Mass., for the Enterprise Mfg. Company, of Philadelphia, is typical of the advance in forge shop methods. The blast is furnished by an electrically-driven fan arranged for suspension from the ceiling where it will occupy no valuable space. A special electric exhaust fan positively draws away all smoke and gases from the fires, with the result that the room is kept clear and fresh as any other part of a manufacturing plant.

REEVES ENGINE COMPANY.—On and after May 1 the offices of the sales manager of the Reeves Engine Company, Mr. R. H. Reed, will occupy more spacious quarters in the Singer Building, 85 Liberty Street, New York City. The growing business of the company has called forth increased facilities in several branches of its equipment, especially in its New York offices, where important orders from all parts of the country are handled. This office is in constant touch with the factory at Trenton, N. J., which is in a better position than ever before for handling large orders and making prompt deliveries.

THE NATIONAL ELEVATOR & MACHINE COMPANY, of Honesdale, Pa., has recently been reorganized with Mr. H. F. Gurney as president and Mr. E. R. Carichoff as consulting engineer. A number of contracts have been closed recently by the new management, including equipments for four apartment houses in New York calling for five, four, three and two elevators, respectively. Orders have also been received for single elevators for 11 buildings in New York, including one for the Presbyterian Board of Foreign Missions and the other for the Corporation of Trinity Church. The company has just moved its offices to 400 West 23d Street, New York.

VENTILATING APPARATUS.—The building of the H. K. Porter Company, in Pittsburg, Pa., is ventilated and heated by the special plenum heating system and coke air washing apparatus. The entire equipment was designed and installed by the B. F. Sturtevant Company, of Boston, through its local Pittsburg office. The heating apparatus, consisting of fan, heater and belted motor, is installed in the basement in conjunction with the washer, which consists of a metal supporting frame filled with broken coke, over which water is allowed to trickle. The air as it passes between the fragments of coke is thoroughly cleansed of smoke and dust, which is washed down by the water to the

bottom of the device and there removed. Previous to the installaton of this plant, drawings, papers and the like became very dirty. It is now reported that they are kept perfectly clean at all times, owing to the fact that no air can go into the building except through the heating apparatus, where it is very thoroughly and effectively cleansed. The slight pressure maintained within the building causes outward leakage at all points. It is anticipated that the same equipment will prove very advantageous for ventilating purposes during the summer time.

WESTINGHOUSE NEW YORK OFFICE CHANGES.—Westinghouse interests will occupy all but a small part of the nineteenth and twentieth floors of the new Trinity Building, at 111 Broadway, New York, after May 1. The executive offices of the Westinghouse Electric & Mfg. Company, which have for nearly twenty years been in the Equitable Life Building, at 120 Broadway, will be on the nineteenth floor of the new building, and the Eastern sales offices of the Westinghouse Air Brake Company and the Westinghouse Traction Brake Company will occupy a large part of the twentieth floor. The law offices of Hunt, Hill and Betts, which have been for several years in the Equitable Life Building, will be on the twentieth floor of the new building, and the remaining part of the floor has been sublet to an engineering company. The new offices in the Trinity Building will be more commodious to provide for the growth of the working staff in the treasury and other departments. The New York sales offices of the company will remain in the Hanover Bank Building at Pine and Nassau Streets, without changes, and the New York office of the Westinghouse Companies' Publishing Department, formerly at 10 Bridge Street, will be connected with them. The export offices of the electric company will continue at the same address, under the management of Mr. Maurice Coster, recently appointed to succeed Mr. F. B. H. Paine, and the office of Mr. Charles S. Powell, the new general agent of the electric company will be connected with the sales and export offices. Mr. Coster and Mr. Powell have arrived from Paris and from London to take up their new duties after long terms of successful Westinghouse service abroad.

# Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED APRIL 18, 1905.

[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

787,361. TELEPHONE-TRANSMITTER; John Erickson, Chicago, Ill. App. filed May 4, 1903.

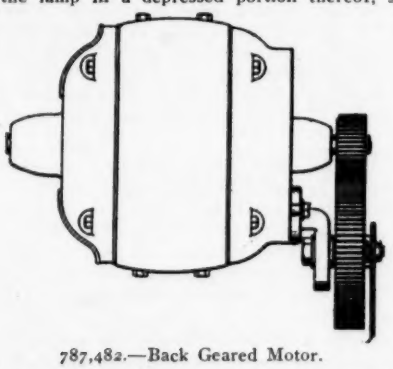
787,371. LIGHTNING ARRESTER; Lara M. Gates, Chariton, Iowa. App. filed Aug. 16, 1904. A device to be applied to the outside of a building in connection with telephone circuits, and provided with a push rod to be operated from the inside upon the approach of a storm, so that excessive currents from lightning discharges will be conducted to the ground instead of through the instruments.

787,372. BURGLAR AND FIRE ALARM; William Giles and Henry Ramsey, Mammoth, W. Va. App. filed Sept. 30, 1904. Details.

787,393. SIGNAL SYSTEM AND APPARATUS THEREFOR; Frank P. J. Patenall and George H. Dryden, Baltimore, Md. App. filed Jan. 23, 1905. The feature of the system is a relay comprising two electro-magnets connected in parallel and located on opposite sides of an armature lever pivoted at the middle, whereby a certainty of operation is obtained with relatively light battery power.

787,419. ELECTRIC BLOCK SIGNAL; Walter Williams, Wadesville, Ind. App. filed Oct. 1, 1904. The system comprises a device whereby the direction of movement of trains is indicated by the period during which an alarm is sounded, the alarm being automatically controlled by the train.

787,428. INCANDESCENT ELECTRIC LAMP; Frank H. Blackburn, Fostoria, Ohio. App. filed Jan. 6, 1904. The exhaustion tube is applied at the neck of the lamp in a depressed portion thereof, so that when the



787,482.—Back Geared Motor.

lamp is sealed the tip is covered by the metal base of the lamp and the bulb is otherwise left smooth.

787,442. INSULATOR FOR ELECTRIC WIRES; Samuel B. Flynt and Leaman A. Maiden, Meridian, Miss. App. filed Aug. 1, 1904. A protector for glass insulators, comprising a two-part casing to be fastened upon the same and having external grooves for the wires to be supported.

787,482. BACK-GEARED MOTOR; Leonard A. Tirrill, Lynn, Mass. App. filed Aug. 5, 1904. The counter-shaft for the gear engaging the motor pinion is held in a bracket adjustable radially in a seat formed in the end plate or head of the motor.

787,489. CONTROLLER FOR PNEUMATIC COMPRESSORS; Bror F. Bergh, New York, N. Y. App. filed Dec. 12, 1903. A mechanical device for automatically starting and stopping the motor driving an air compressor.

787,507. AUTOMATIC ANNUNCIATOR-RESTORER; James I. Gemmill, Cleveland, Ohio. App. filed Dec. 22, 1902.

787,527. TROLLEY RETRIEVER; Francis M. Miller, Arcadia, Ind. App. filed Feb. 2, 1905. A casing containing a continuously driven pinion and a winding drum to which the trolley cord is attached, is mounted on a part of the car in such a manner that the upward movement of the trolley pole throws the pinion and drum into gear, causing the latter to wind the cord.

787,561. ELECTROSTATIC APPARATUS; Eugene W. Caldwell, New York, N. Y. App. filed Feb. 3, 1905. An induction coil is used to impart an initial charge to an electrostatic generator.

787,583. TELEPHONE-RECEIVER; Charles T. Mason, Sumter, S. C. App. filed Feb. 27, 1905.

787,584. DENTAL FURNACE; Arthur E. Matteson, Chicago, Ill. App. filed Sept. 19, 1904. A muffle having a number of lugs on its outer surface, between which the heating resistance is stretched.

787,595. ELECTRIC TRAIN SIGNAL; Albert W. Sullivan and William Renshaw, Chicago, Ill. App. filed Aug. 5, 1904. A motorman's signal, including circuit controllers actuated by the doors of the train so that the starting signal can be given only when all doors are closed.

787,610. TELEPHONE-TRANSMITTER; Henry P. Claussen, Chicago, Ill. App. filed Aug. 19, 1901.

787,658. INDUCTION COIL; John A. Baker, Seguin, Tex. App. filed June 13, 1904. A primary winding composed of a broad strip wound in spirals at right angles to the axis and a fine wire secondary winding wound in the spaces between the spirals, suitable disks of insulating material being interposed between the adjacent sections.

787,684. TROLLEY; Louis Leuenberger, Van Ness, N. Y. App. filed Jan. 28, 1905. Two parts of a frame are hinged together, a forward part carrying a roller for engagement with the wire and a rear part carrying two rollers for engagement with opposite sides of the wire; the arrangement is supposed to retain the trolley on the conductor.

787,707. ELECTRIC TOOL DRIVER; William F. Wagner, New York, N. Y. App. filed Dec. 7, 1904. An electrically operated and reciprocating driver and a reciprocating commutator comprising a solenoid and contacts arranged to co-operate with the core of the solenoid.

787,722. MOTOR CONTROLLING AND REGULATING DEVICE; Otta C. Britsch, New York, N. Y. App. filed Aug. 31, 1903. The rheostat is

787,658.—Induction Coil.

a body of liquid into which a plunger is thrust to elevate the liquid successively past a series of terminals of a sectional winding.

787,738. MOTOR-STARTING DEVICE; Arthur C. Eastwood, Cleveland, Ohio. App. filed Sept. 9, 1904. (See Current News and Notes.)

787,753. SIGNAL APPARATUS; Clarence B. Gunn, Collinwood, O. App. filed Dec. 15, 1904. A signal circuit is actuated by the pressure in a train pipe system to give warning when the pressure falls below the working point.

787,780. WIRELESS TELEGRAPH SYSTEM; Walter W. Massie, Providence, R. I. App. filed Nov. 1, 1904. A wireless telegraph system involving a sending and at least two receiving circuits, each of the latter involving a receiving instrument and the receiving instruments being of different character, and a means common to the three circuits for closing them.

787,802. COMBINATION GAS AND ELECTRIC FIXTURE; Charles S. Steinberg, New York, N. Y. App. filed May 4, 1903. A gas pipe and conduit for wires, extending through the hollow stem of the chandelier, the upper end of the conduit turning laterally and opening into the chamber of the canopy, thus affording an opportunity to make connections.

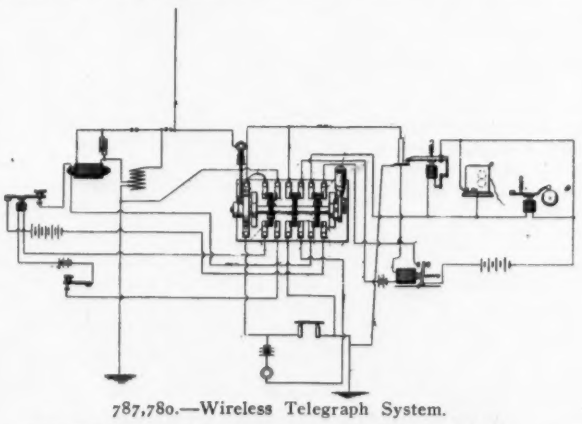
787,810. TROLLEY POLE CATCHER; John H. Walker, Lexington, Ky. App. filed June 6, 1904. Details.

787,820. INSULATION FOR ELECTRIC CONDUCTORS; Lawrence E. Barringer, Schenectady, N. Y. App. filed Jan. 30, 1905. (See Current News and Notes.)

787,827. ELECTRICALLY CONTROLLED RAILWAY SWITCH; Robert V. Cheatham, Louisville, Ky. App. filed Aug. 9, 1904. Details of an electromagnetically operated switch tongue.

787,839. MECHANICAL ARM; William H. Ernst, Bloomington, Ind. App. filed Nov. 17, 1904. A cross arm for temporary use in sustaining the wires on a pole while an old arm is being replaced by a new one.

787,856. SWITCH FOR SUSPENDED ELECTRIC RAILWAYS; Rudolf Pfaffenbach, Leipsic, and Hermann Muller, Leipsic-Gohlis, Germany. App. filed Oct. 29, 1904 Details.



787,780.—Wireless Telegraph System.

787,879. TELEPHONE CALL OR RINGER; Charles E. Egan, Durham, N. C. App. filed Aug. 13, 1902.

787,880. SYSTEM OF ELECTRICAL DISTRIBUTION; Justus B. Entz, Philadelphia, Pa. App. filed Apr. 23, 1904. The system comprises a working circuit, a battery provided with a booster, an alternating generator feeding the working circuit and having a commutator, a prime mover for the generator and connections between the commutator and battery, whereby the frequency of the current generated and of the superimposed battery current is the same.